Fluke Thermography

Agenda

- Overview of Thermography
- Benefits of Thermography
- Who Uses Infrared Cameras?
  - Equipment Applications
  - Vertical Segments
  - Key Users
- Intro to Fluke Ti Product Family

Thermography then and now:

A few years ago:

- Avg. Price per unit > $20K
- Typical User – Professional
- Where Used – Larger customers, government

Now:

- Avg. Price per unit < $10K
- Typical User – Maintenance Tech
- Where Used – General Mfg, Bldg Science, Health Science

Overall improvement in the Return on Investment (ROI) for customers has dropped from “Years” to “Months”

Overview of Thermography

What is Thermography?

•Measurement of temperature remotely to indicate equipment health

•Thermography is the temperature measurement of several points and assigns a color based on the temperature:

- •Uses standard color palette: Red is hot/blue is cold
- •Brighter colors are warmer/darker colors are cooler

•Thermography cameras produce a picture that details this information in an easy to use format

- Easier to use
- More affordable
- Finding more applications

Overview of Thermography

What is the Benefit?

- High heat is key indicator of equipment failure:
  - Find hot spot
  - Fix equipment before failure
  - Equipment operating efficiently

- Average cost of downtime for a given piece of equipment is greater than **$20K/hour**

- Enables Service/Installer/Maintenance technicians (YOU!) to stop fighting fires and fix problems before they result in large-scale losses

- Measurement is…
  - Non-contact
  - Obtained without disturbing production
  - Applies to all types of equipment
  - Reliable data
  - Quickly identifies specific location
  - Apply to most all conditions

Average Downtime Costs: Lost Revenues

Industry Sector	Revenue/Hour
Chemicals	$704,101
Construction and engineering	$389,601
Electronics	$477,366
Energy	$2,817,846
Food/beverage processing	$804,192
Manufacturing	$1,610,654
Metals/natural resources	$580,588
Pharmaceuticals	$1,082,252
Utilities	$643,250

Overview of Thermography

Locating problems before failure has high value
•Increased safety
•Improved reliability
•Reduced fire fighting
•Reduced unscheduled outages
•Reduced maintenance and repair costs
•Improved production rate and quality
•Better assurance of repairs and new installations

Thermography – Uses and Users

Where is Thermography Used?
•Vertical markets: industrial, utilities, local & state governments, petroleum/gas, construction/restoration, paper & pulp mills, data centers, human & animal medical, R & D, etc. •Equipment Applications: engines, drives, motors, Electric Motor Bearings and Windings, belts, electrical panels, switchgear, power lines, UPS systems •Building Diagnostics: Furnaces, HVAC, Roofs, building envelopes including Water Restoration, Mold Remediation and Pest Control

Overall–Most of You will be able to use thermography right away and improve your facility's uptime quickly.

Infrared Camera Applications

Industrial Equipment Applications

Electrical systems

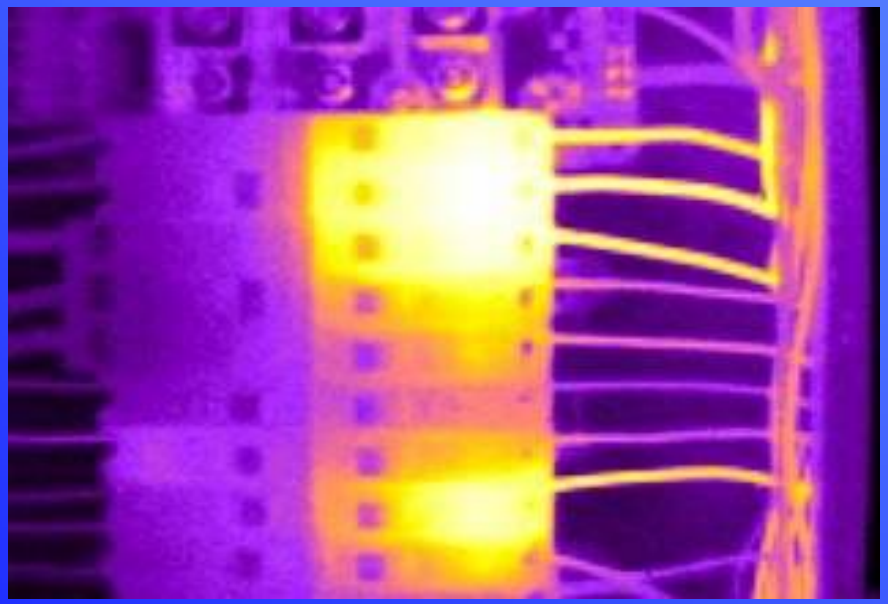
Commonly inspected components

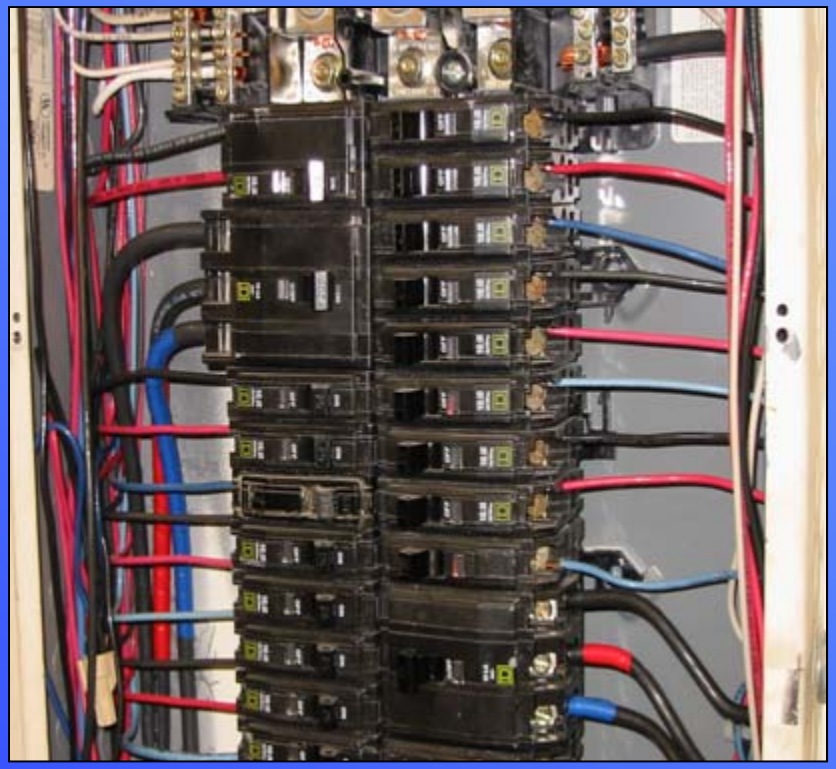
- (3 phase) Power distribution
- Fuse boxes
- Cables & connections
- Relays/Switches
- Insulators
- Capacitors
- Substations
- Circuit breakers
- Controllers
- Transformers
- Motors
- Battery banks

Typical reasons for temperature hotspots or deviations

- Unbalanced loads
- Harmonics (3rd harmonic current in Neutral)
- Overloaded systems/excessive current
- Loose or corroded connections increased resistance in the circuit (typically one side of components heats up)
- Insulation failure
- Component failure
- Wiring mistakes
- Underspecified components (like fuses) would heat up on both side of the fuse

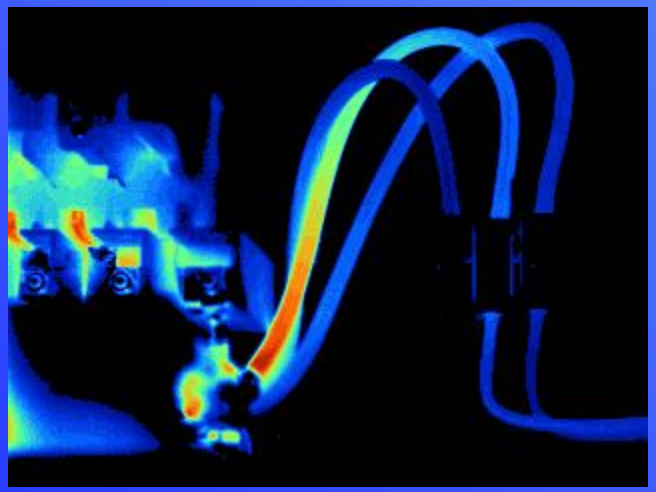
Maintenance Thermography

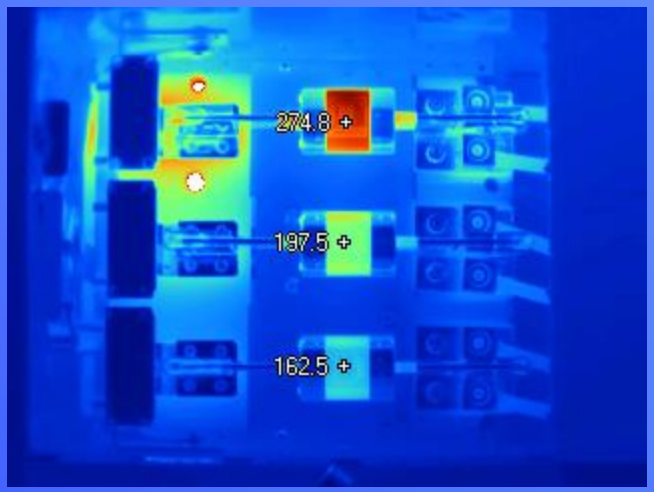


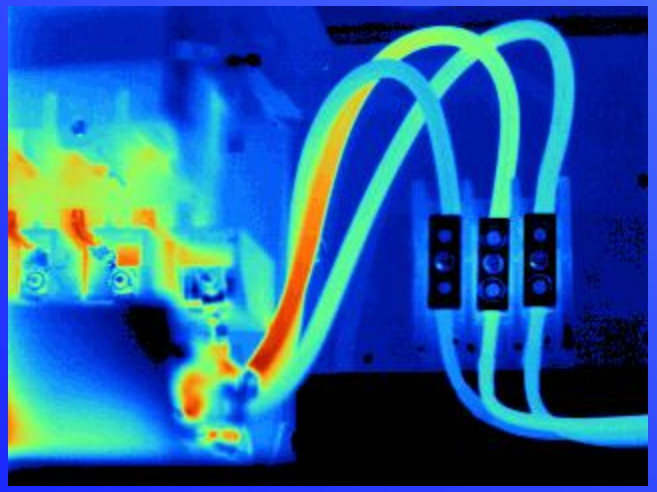


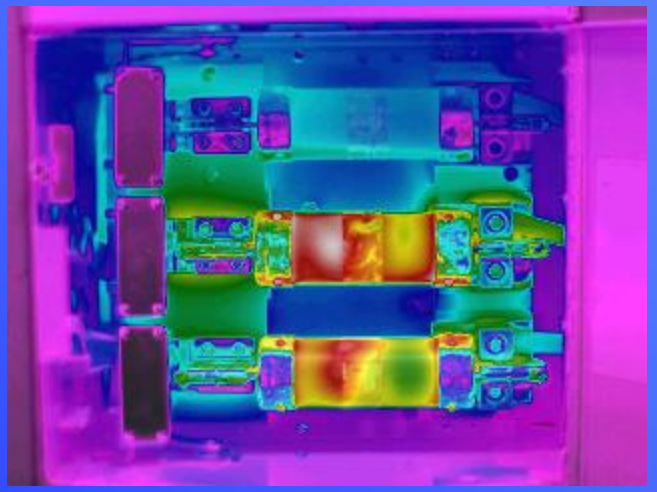
Two lighting breakers are 35°F above ambient

Electrical



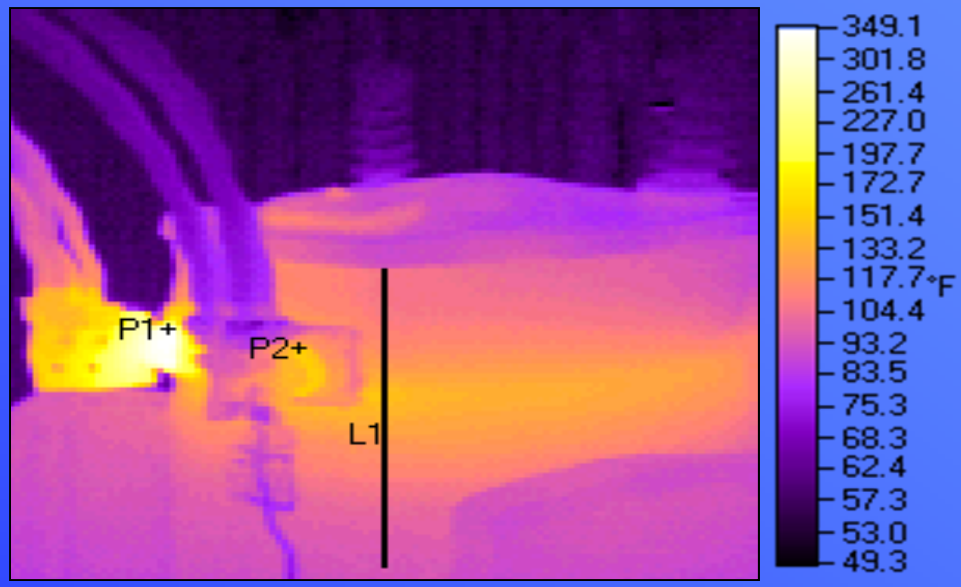




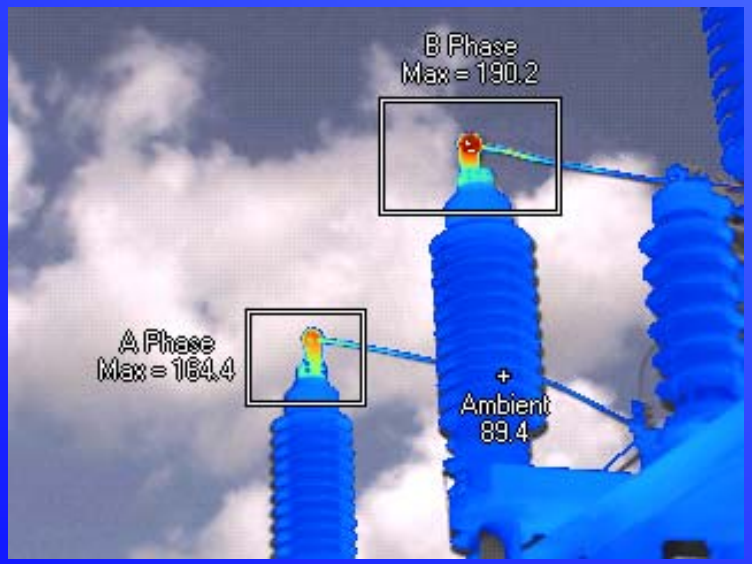


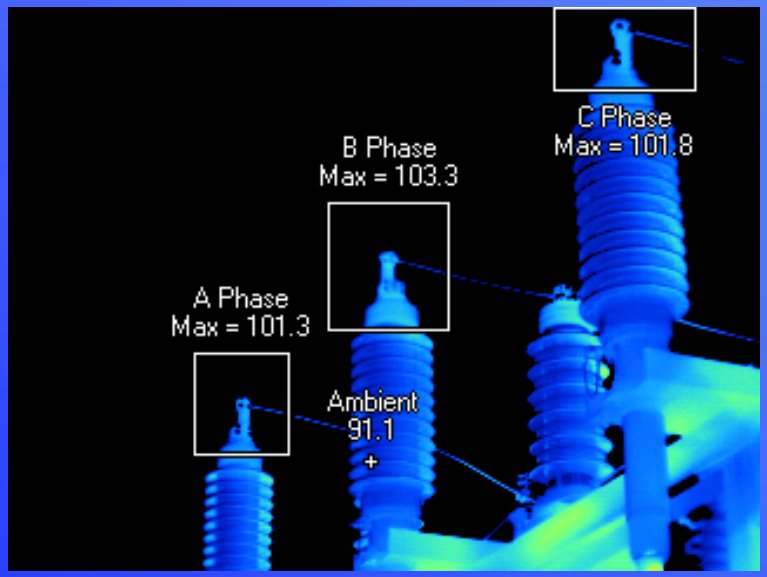
Overheated Transformer Report

Near catastrophic failure! Found and managed until normal factory shut down.



Power lines and Sub-stations

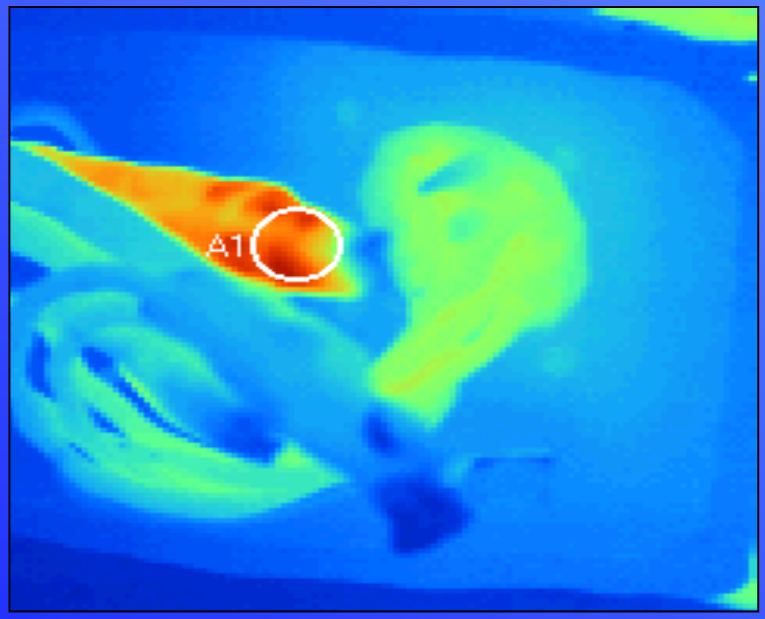


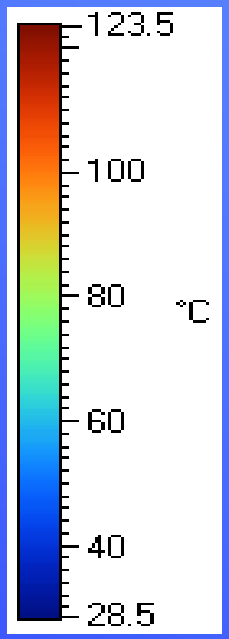


Electromechanical

Commonly inspected components	Typical reasons for temperature hotspots or deviations
• Motors • Pumps • Heat exchangers	• Bad cooling- due to reduced airflow • PQ problems like unbalance, overload or 5th harmonic (voltage) will cause heat dissipation • Bad alignment • Insulation problems with motor windings • Bearing problems – lubrication, wear, etc.

High Resistance Connection





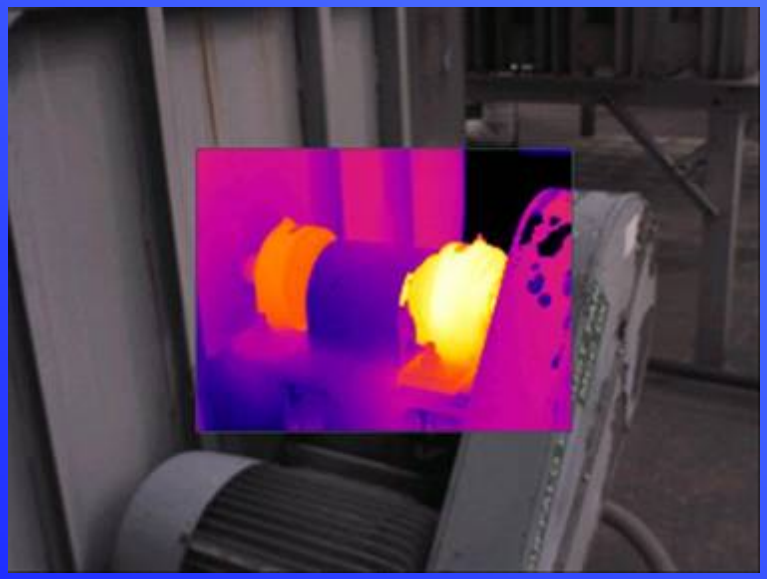
3-Phase Connector Before Repair

3-Phase Connector After Repair

150 HP Motor

Mechanical systems

Commonly inspected components	Typical reasons for temperature hotspots or deviations
• Bearings • Gearboxes • Drive belts	• Friction due to wear, misalignment or inadequate lubrication



Process installations

Commonly inspected components

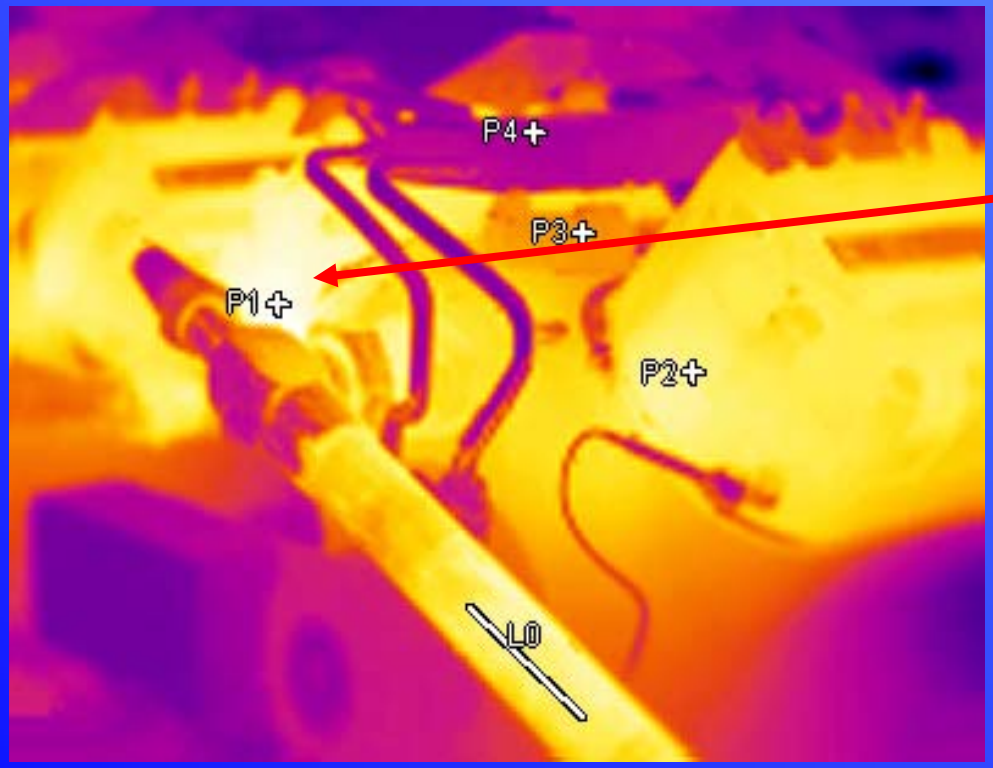
- Refractory insulation
- Tanks and vessels
- Steam systems/traps
- Pipes and valves
- Heaters/Furnaces
- Manufacturing equipment
- Plastics Industry (Molding)
- Pulp & Paper (Rollers, handling equipment, etc)
- Metal Foundry
- Boilers and Reactors
- Research & Development

Typical reasons for temperature hotspots or deviations

- Damaged structures caused by worn pipes etc
- Abnormal heat flow/heat gradients
- Gas or steam leakage

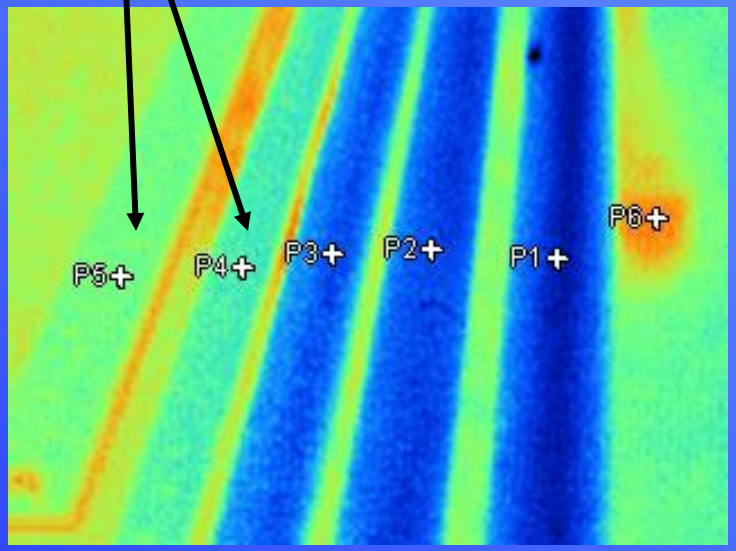
Compressor for in Store Freezing Units

Label	Emis	BG	Ave	SD	Max	Min
L0	0.95	68.0	235.10	1.90	238.2	230.9
P1	0.95	68.0	252.61	0.00	252.6	252.6
P2	0.95	68.0	239.45	0.00	239.5	239.5
P3	0.95	68.0	189.05	0.00	189.1	189.1
P4	0.95	68.0	109.18	0.00	109.2	109.2

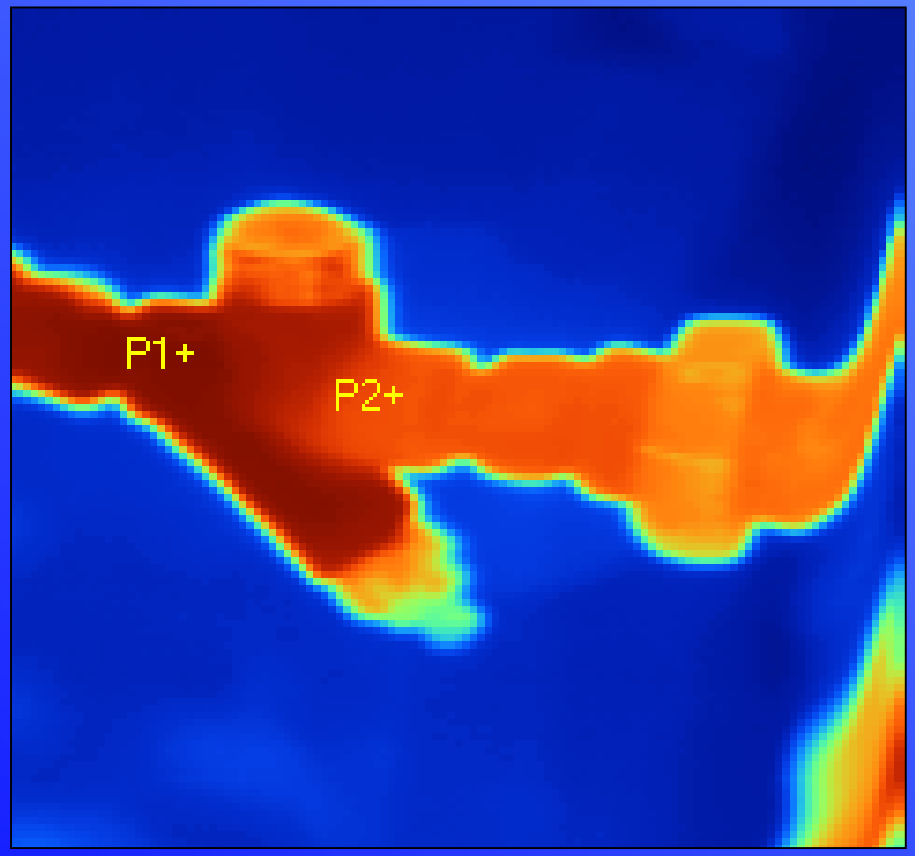


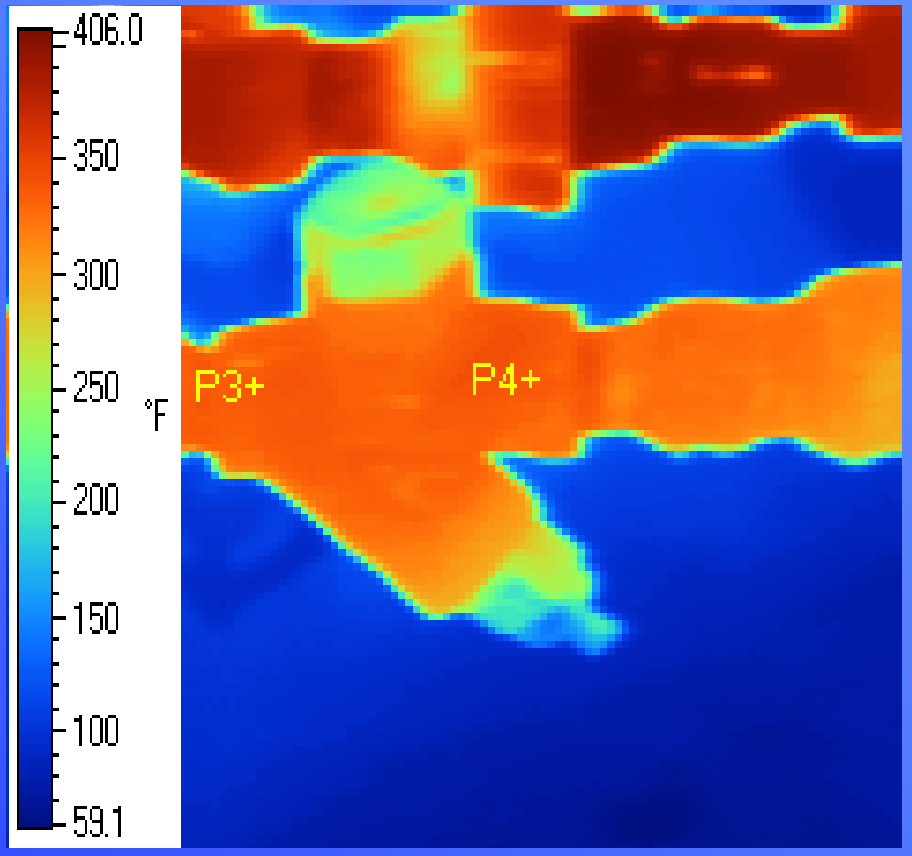
➢Problems here!

➢Caused this problem



Steam Traps





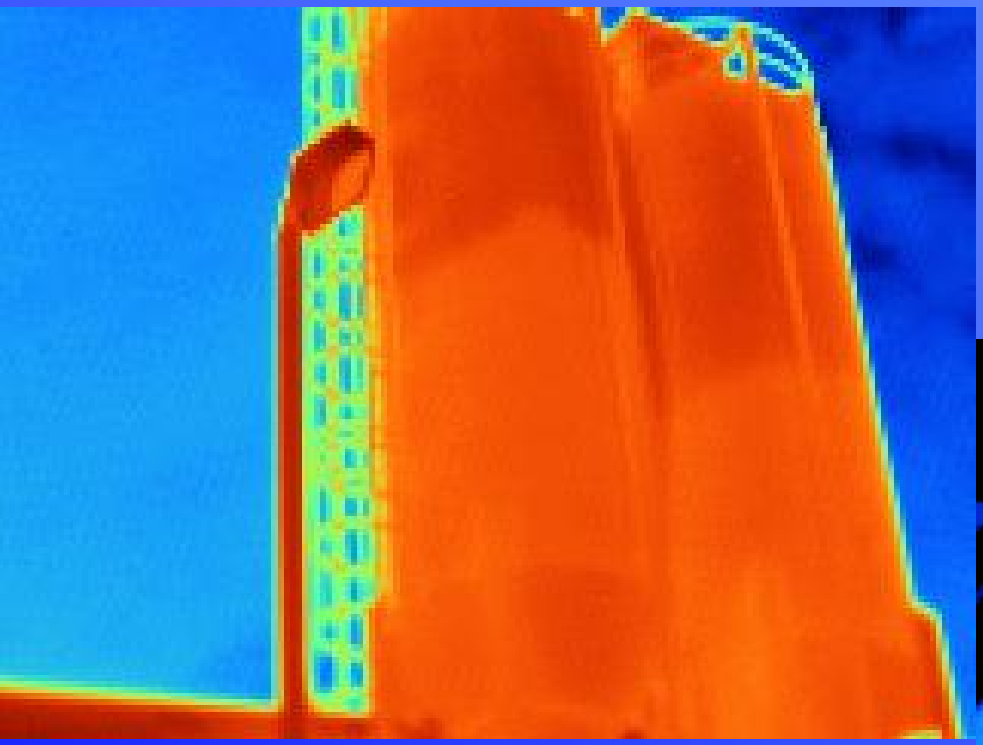
Working

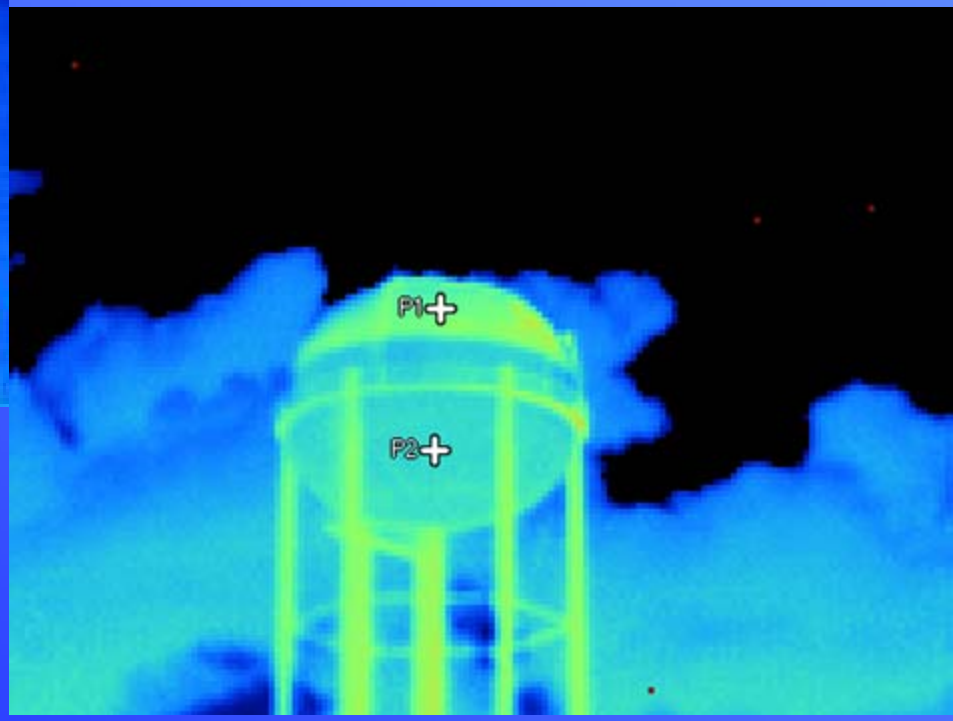
Delta T = 63°F

Failed

< 1°F

Tank Levels





Buildings

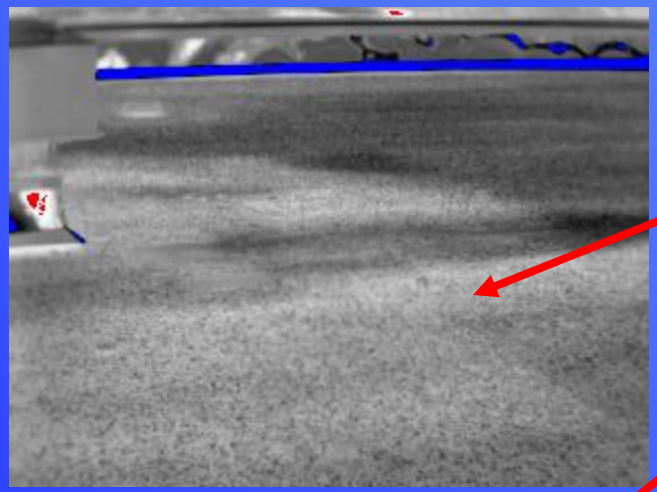
Commonly inspected components

- Walls
- Roofs
- Windows
- Doors
- HVAC
- Insulation
- Floor heating

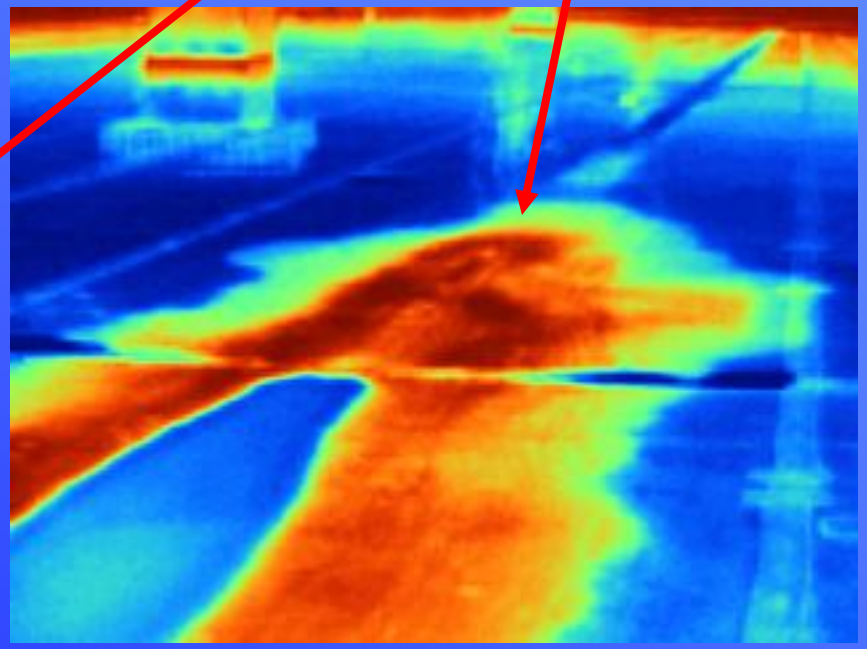
Typical reasons for temperature hotspots or deviations

- Insulation verification like improperly installed or missing insulation
- Roof inspections; leaks cause water to enter to insulation
- Construction evaluation
- Locate air leakage
- Moisture intrusion; damage to insulation and building materials
- Mold detection
- Thermal bridging in joints between walls
- Heat loss through damaged seals in multi-plane windows
- Damaged heat ducks/leakage of buried steam lines

Roof Inspection



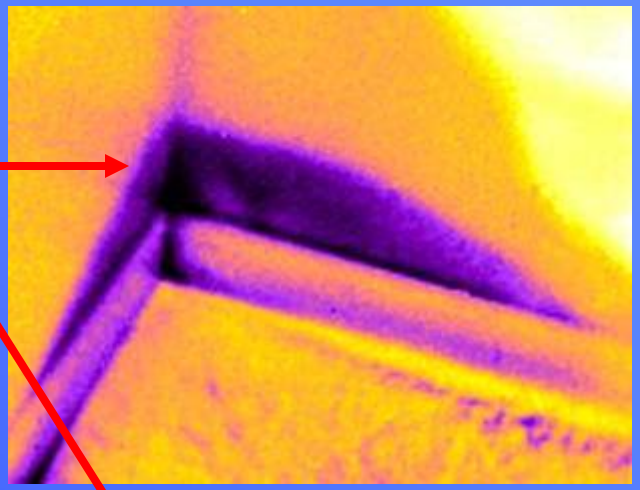
Wet spots under roof membrane

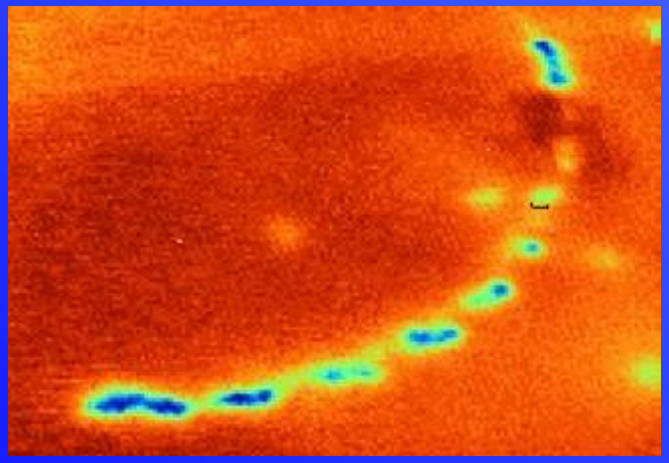


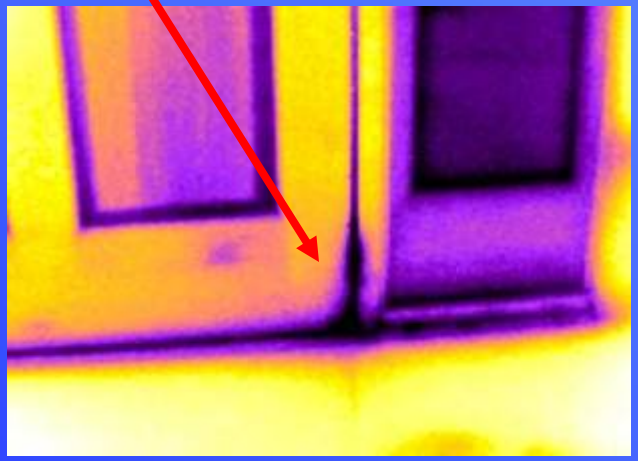
Building Envelope

Moisture and air infiltration

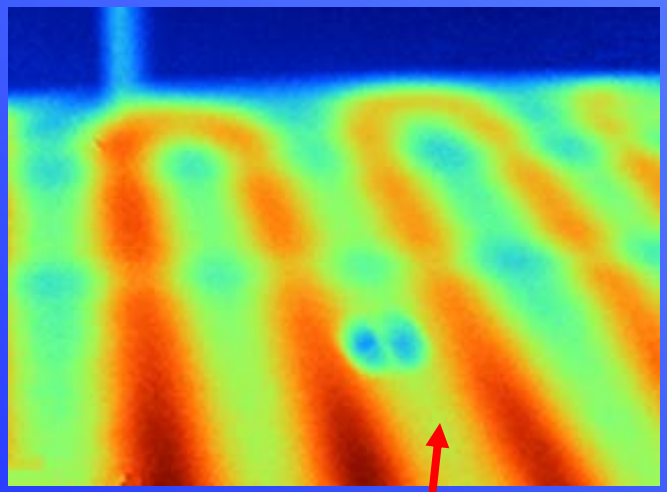
- Moisture behind sheet rock
- Air infiltration around door
- Water drops 3 hrs after a shower

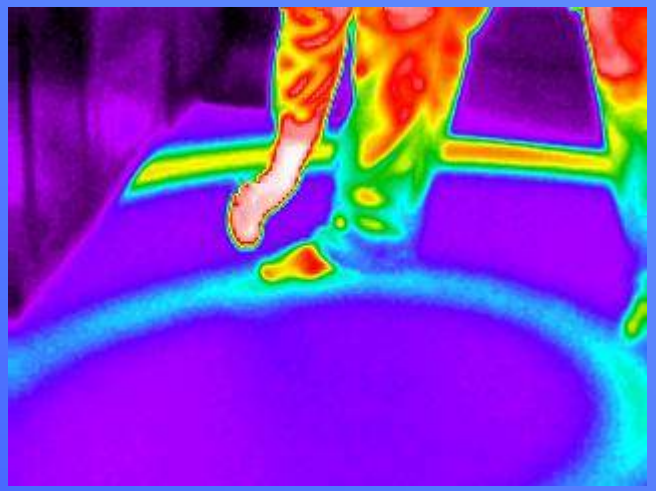


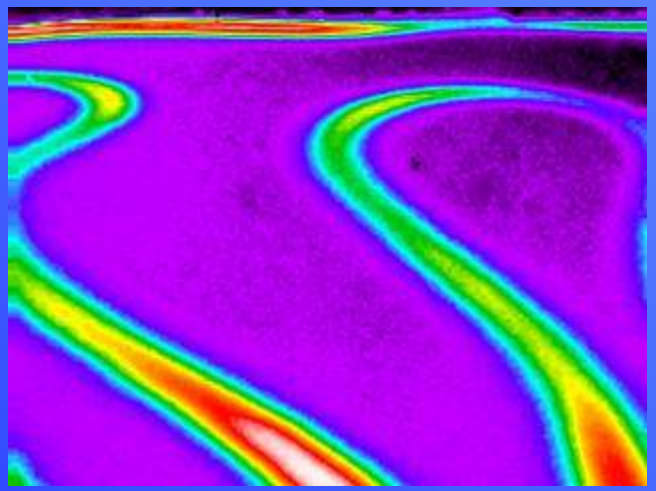




Bridge Deck / In-Floor Heating





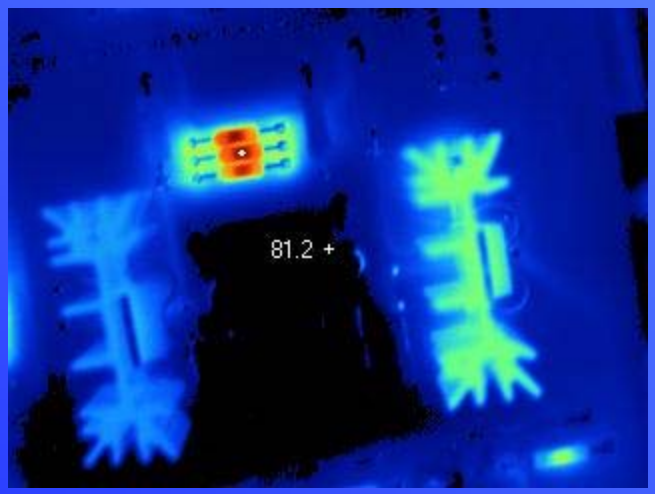


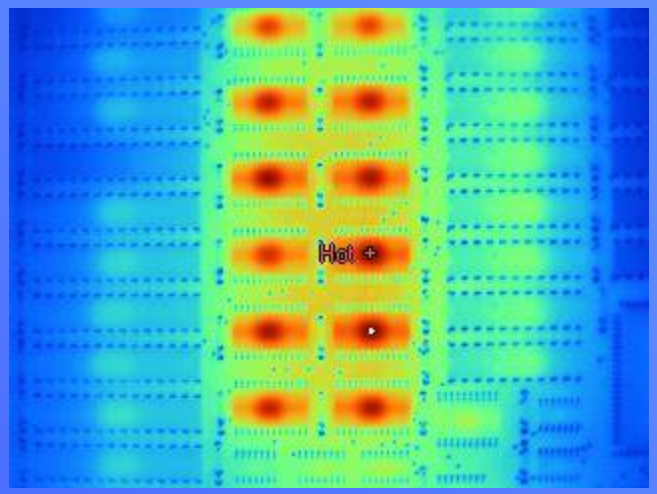
- Hwy bridge deck with ground water heating
- In-floor hot water heating

Electronics

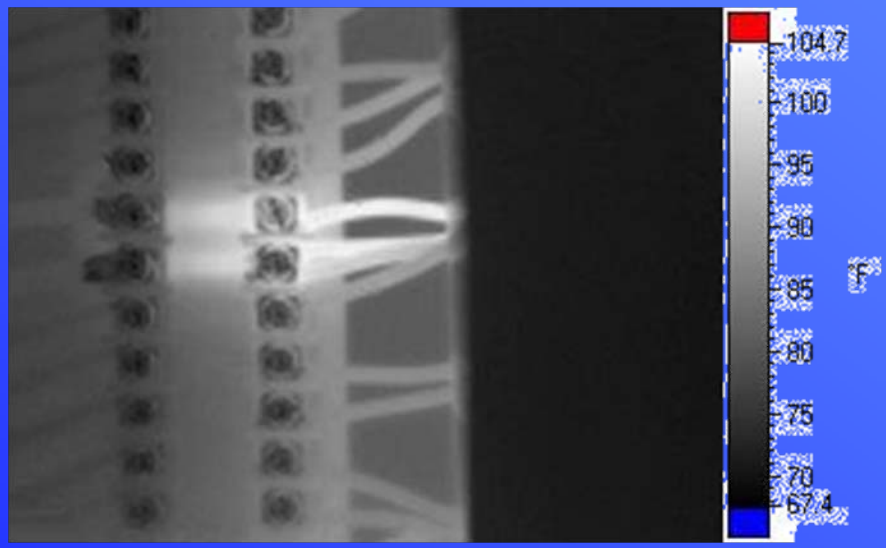
Commonly inspected components	Typical reasons for temperature hotspots or deviations
• Electrical components and sub assemblies • Circuit boards Assemblies	• Under designed components • Component failure • Improper soldering • Broken traces • Reversed polarity

Troubleshooting Electronic Boards

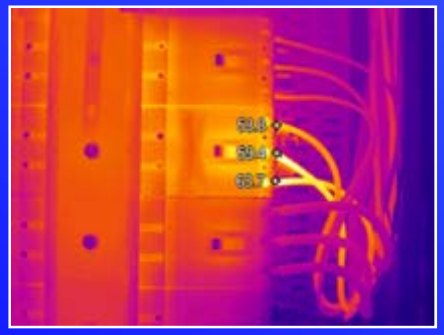


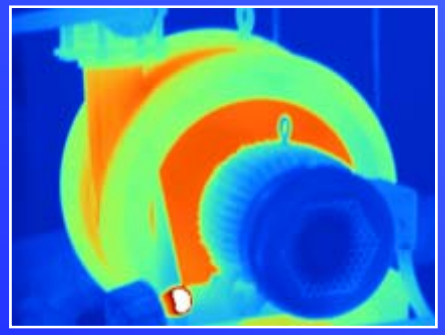
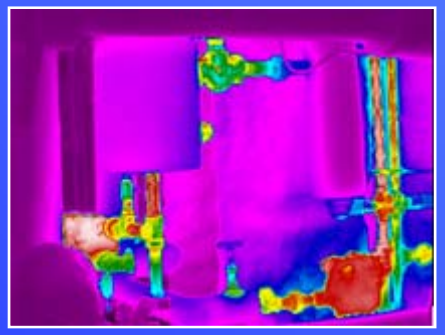
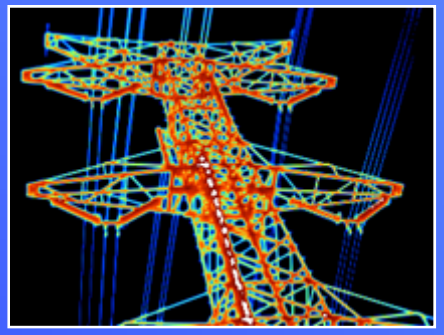


Printed circuit board testing can find either poorly specified components at the design phase or failing components in the field.



The new face of thermal imaging

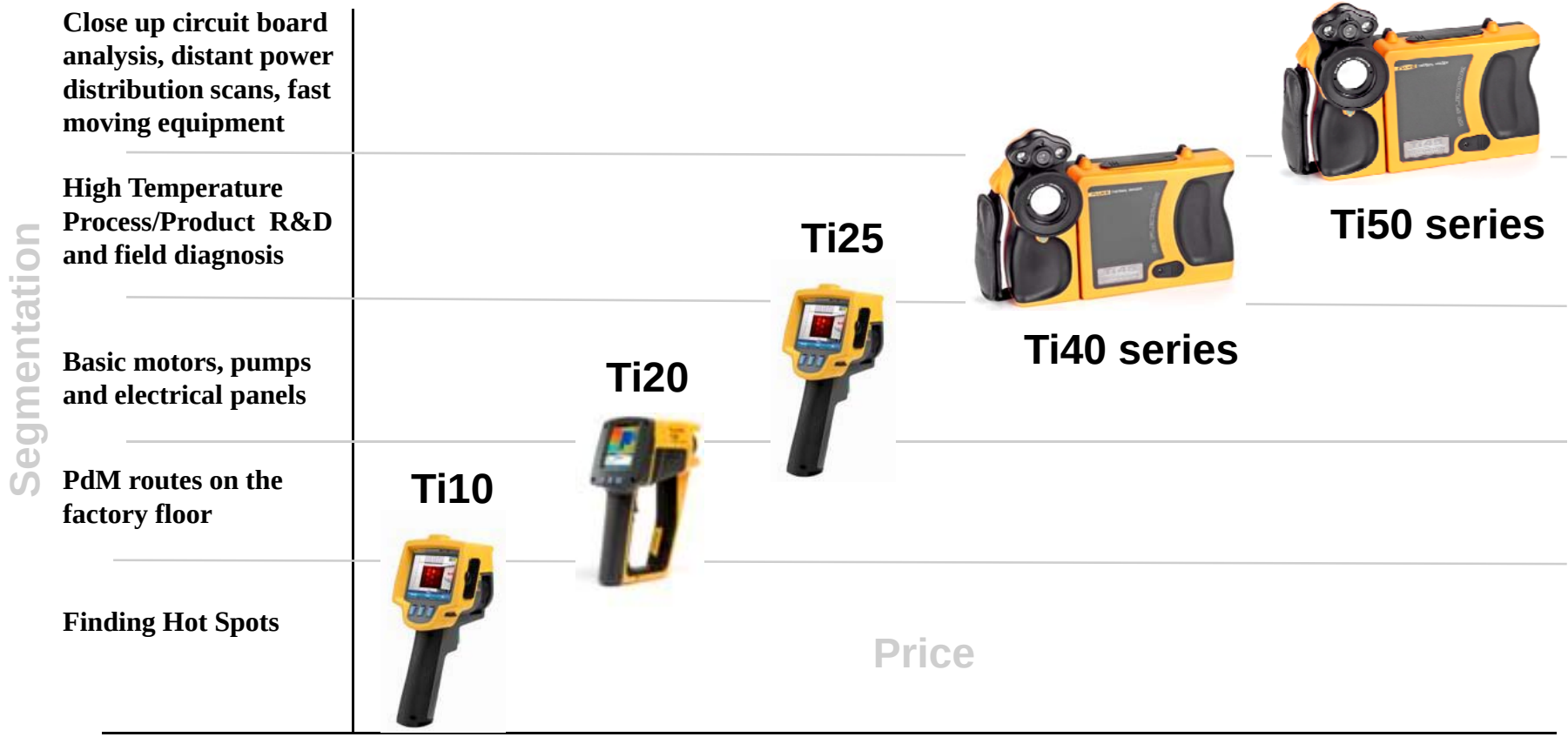


Leading innovation

- Ti30: first fully radiometric unit under $10K
- Ti20: breakthrough price-to-performance
- FlexCam Series (Ti40/50): leading image capability combined with ergonomic usage
- Fusion: breakthrough visual light-thermography image management
- Ease of use: all of our products are *intuitive*

Rounding out the Ti Line



Rounding out the Ti Line

New users	Experienced users/specialists
Mostly qualitative imaging	Qualitative & quantitative imaging
Industrial & building diagnostics	Ind, BD, utilities, electronics
Troubleshooting, (preventive) maintenance	
Predictive maintenance	
In depth analysis	

Ti4X & Ti5X Series

Ti 4X & Ti5X Families

- Full frame radiometric video, 14Bit A to D
- 512MB memory card stores
  - 3,000 images IR images or 200 Fused images
- Sun readable 5” color display
- Articulating lens
- 2 - 3 hour Li-ion battery
- Annotate images
- Easy interface features
  - Window CE compatible
- Full function PC software
  - License Free

Breakthrough technology
180º articulating lens

- A sharp image in every situation
  - The display remains visible while viewing over high objects, under a machine or around immoveable obstructions

FLUKE

FLUKE

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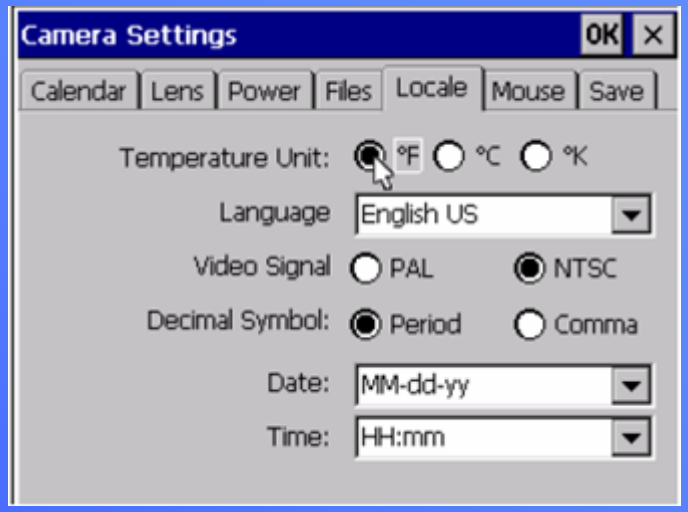
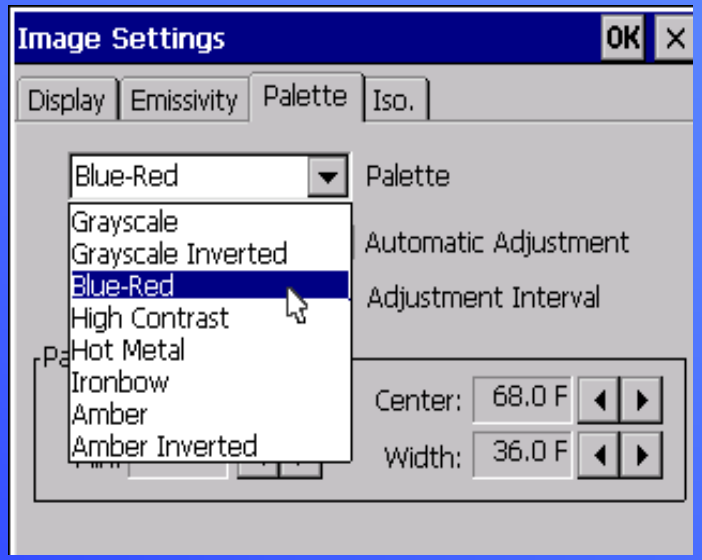
Easy to use instrument

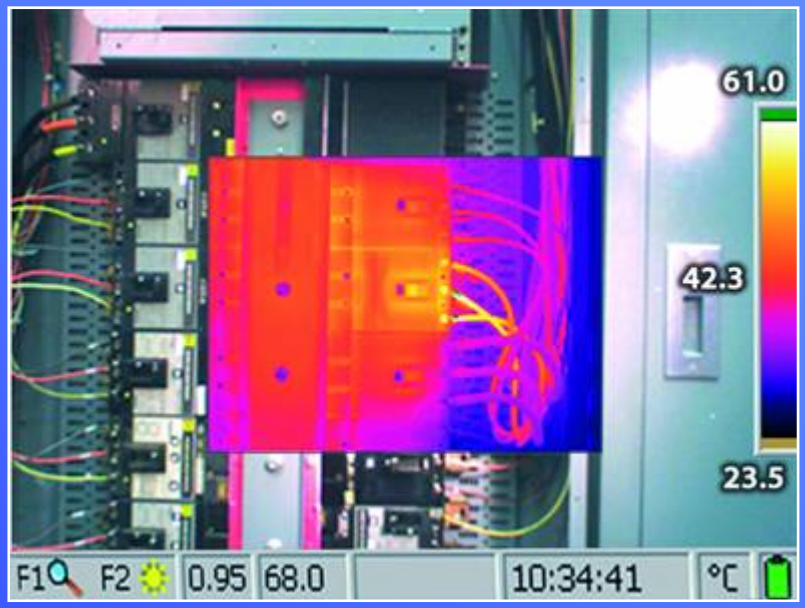
- AutoCapture
  - The instrument is easily set up to automatically capture only those images where a temperature limit is exceeded
  - Troubleshoot Intermittent problems
- SmartFocus
  - No need to take your hand off the instrument to turn a focus ring
- Windows CE based menu structure
  - Intuitive easy to use menu, just like on any PC
- Compact flash memory cards
  - 512 MB card standard to save over 3000 IR images & 200 Fused images

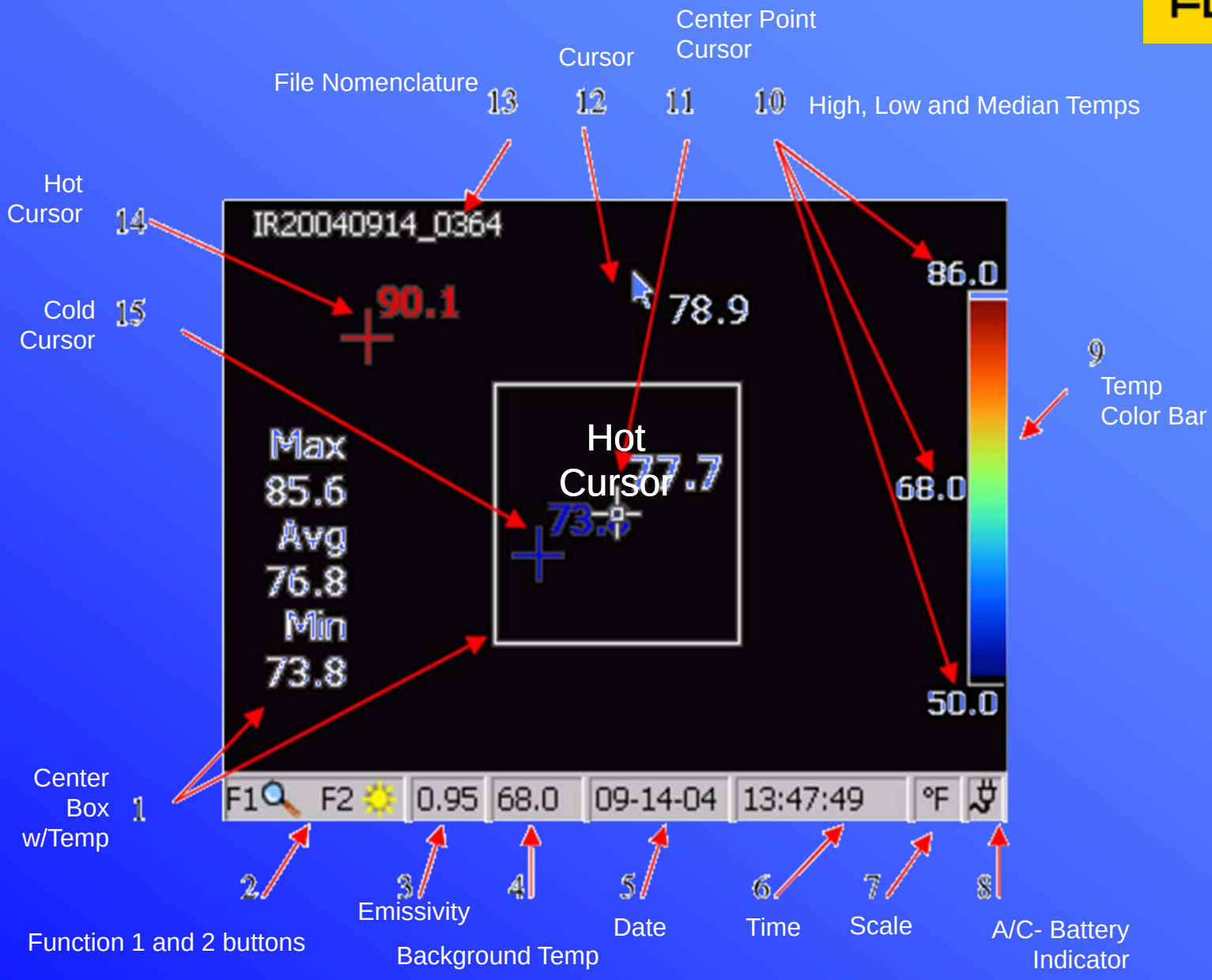




Industry leading image quality

- 5” high resolution, high contrast display
  - The biggest display in the industry
- Superior thermal sensitivity (up to 0.07 ºC using low noise VOx technology)
  - The sharpest images showing the smallest temperature difference
- Choice of 320x240 or 160x120 models



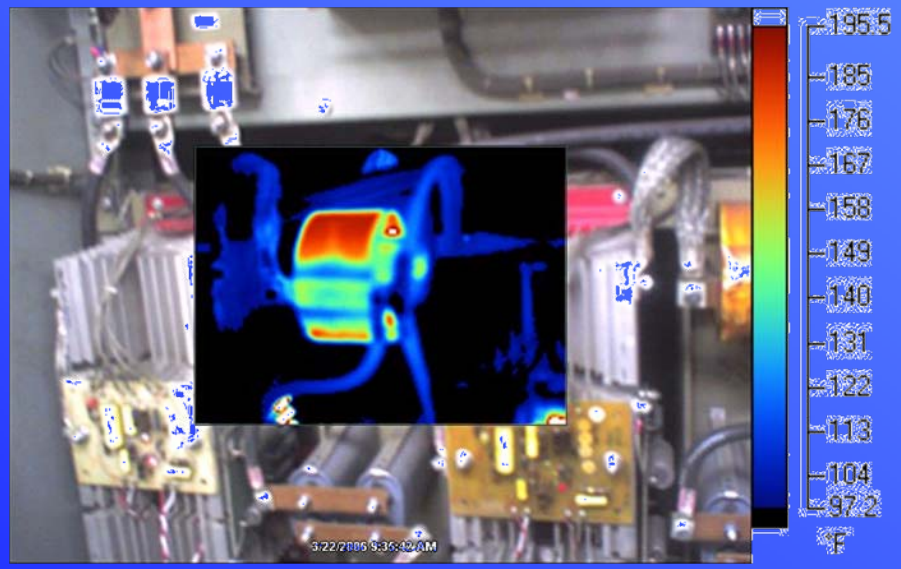

File Nomenclature
Cursor
Center Point Cursor
13
12
11
10
High, Low and Median Temps
Hot Cursor
14
Cold Cursor
15
IR20040914_0364
90.1
78.9
86.0
68.0
50.0
9
Temp Color Bar
Max
85.6
Avg
76.8
Min
73.8
Hot Cursor
77.7
73.8
Center Box w/Temp
1
F1
F2
0.95
68.0
09-14-04
13:47:49
°F
2
3
4
5
6
7
8
Function 1 and 2 buttons
Emissivity
Background Temp
Date
Time
Scale
A/C- Battery Indicator

Level and Span

"Scaling Palette Temperatures"

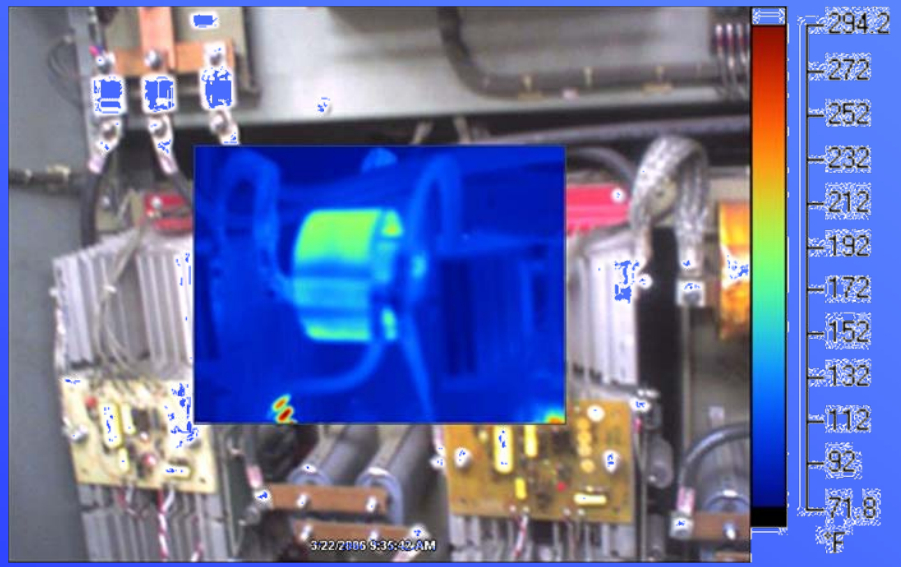
- Cameras can be set for "auto" or "manual" rescaling
- Auto rescaling adjusts image to highest and lowest temp in FOV
- Taking advantage of the manual level and scale adjustment can give you better thermal resolution within the FOV

Level and Span



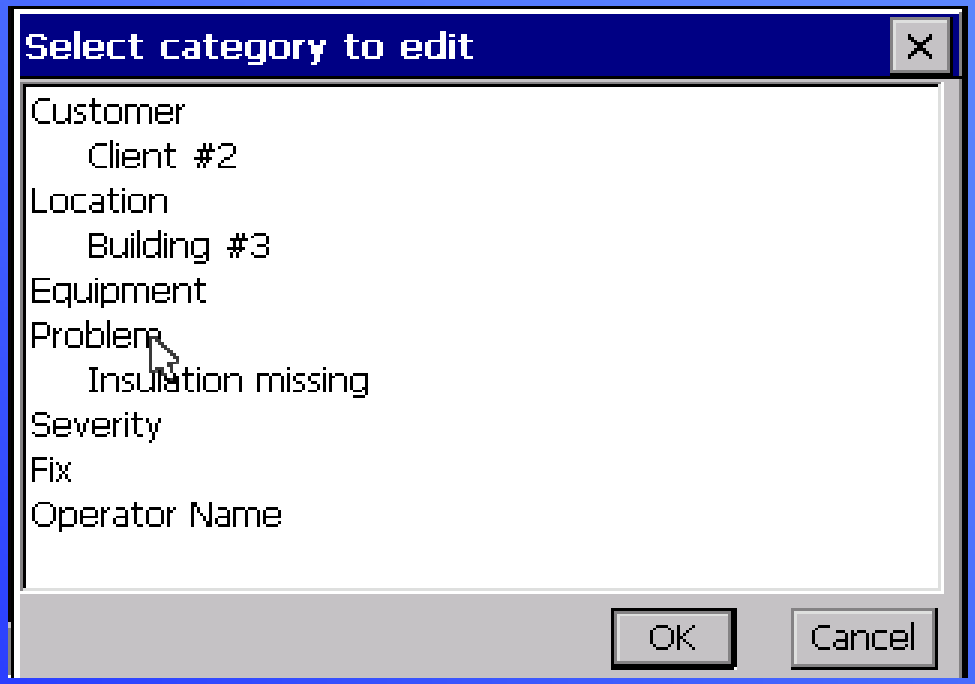
Manually adjusted

Auto Scaled



Annotation Files

- The “Annotation” tool allows the user to create routes with as much detail as needed, including:
  - ✓ Location
  - ✓ Equipment types including ID tag info
  - ✓ List suspected problems
  - ✓ Define severity
  - ✓ Recommended fix
  - ✓ No limit on categories
- Reduces typing
- Reduces report time



The Fluke Ti4X and Ti5X IR FlexCam® Series Thermal Imagers

1. Unique innovative technology
2. Industry leading image quality
3. Powerful analysis and reporting capabilities
4. Easy to use instruments
5. **And ……**

The thermal imagers for PdM experts and consultants looking for the best thermal imager around

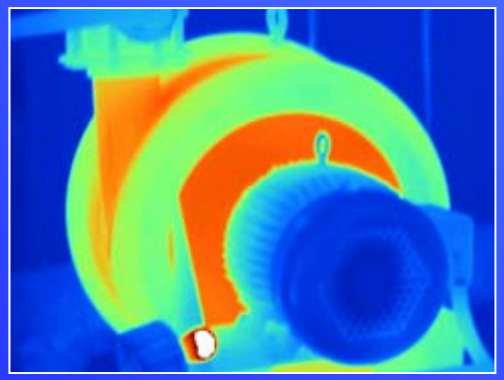
Innovative technology

IR-Fusion™

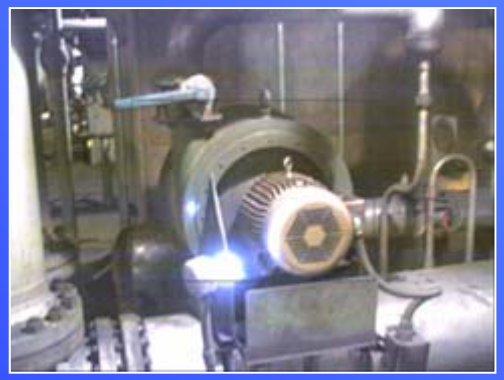
- Infrared and visible light images fused together on one display
- IR-Fusion reveals more detail and pinpoints trouble areas quicker by automatically relating thermal images with the real world
  - Allows for first time right repair by reducing the risk of replacing “good” components

Innovative technology
IR-Fusion™ (on FT models)

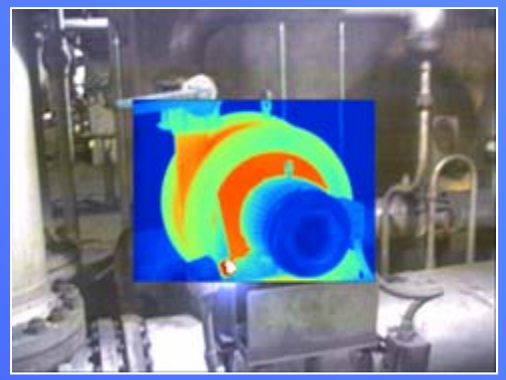
- Five viewing modes



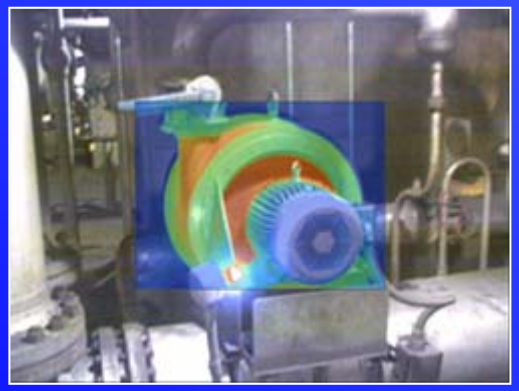
Full IR



Full Visible Light



Picture in Picture

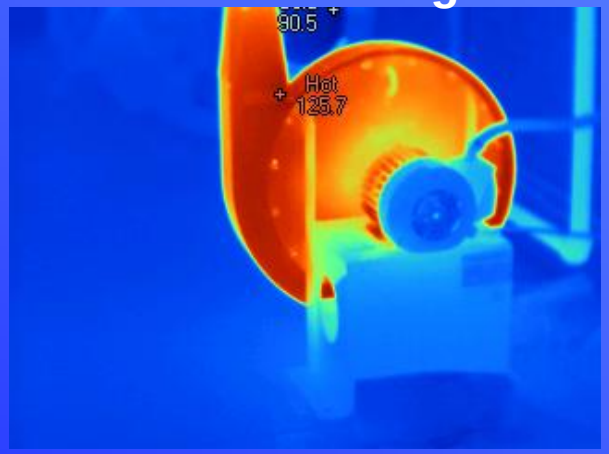


Alpha Blending

IR/Visible Alarms

Blending Example

Infrared Image



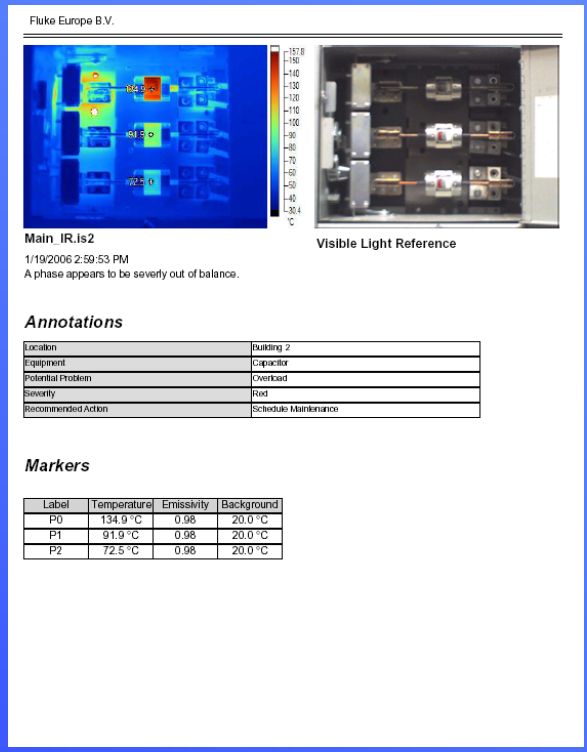
Visible Image

Blended Image

Can Read Infrared Temperatures in Visible Image

Innovative technology
IR-Fusion™

- Read Infrared Temperatures in Visible Image



Fluke Europe B.V.

Main_IR.is2

1/19/2006 2:59:53 PM

A phase appears to be severly out of balance.

Visible Light Reference

Annotations

Location	building 2
Equipment	Capacitor
Potential Problem	Overload
Severity	Red
Recommended Action	Schedule Maintenance

Markers

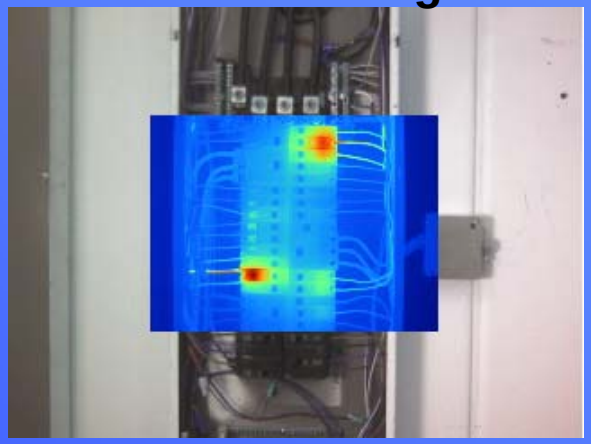
Label	Temperature	Emissivity	Background
P0	134.9 °C	0.98	20.0 °C
P1	91.9 °C	0.98	20.0 °C
P2	72.5 °C	0.98	20.0 °C

- Always a visual image available for better reporting

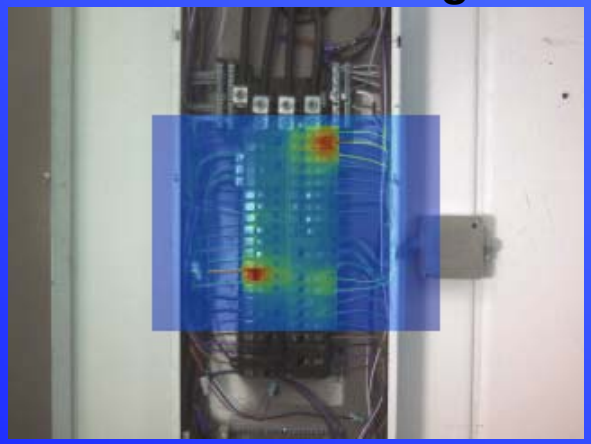
Picture in Picture Example

Visible Image

Infrared Image

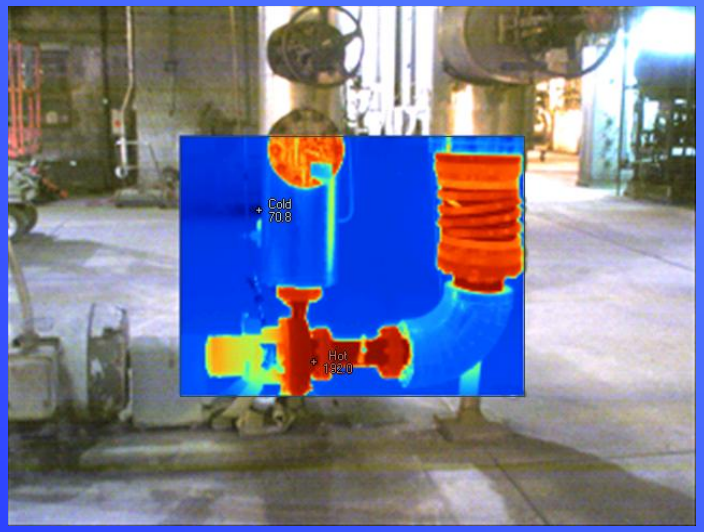


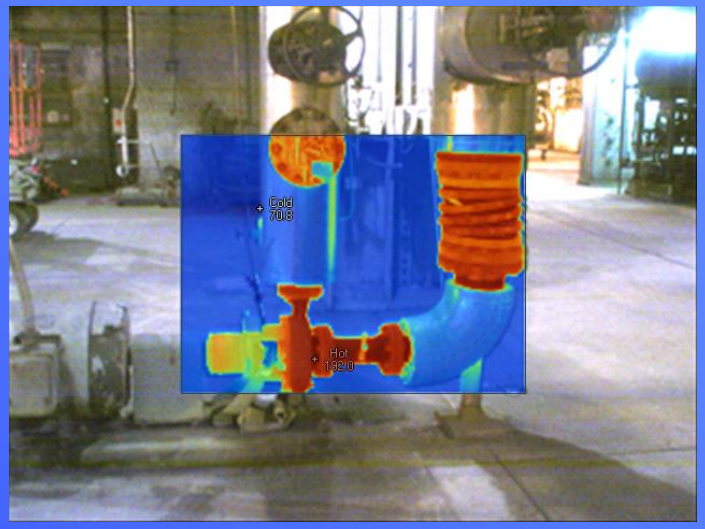
Blended Image



Percent Blending

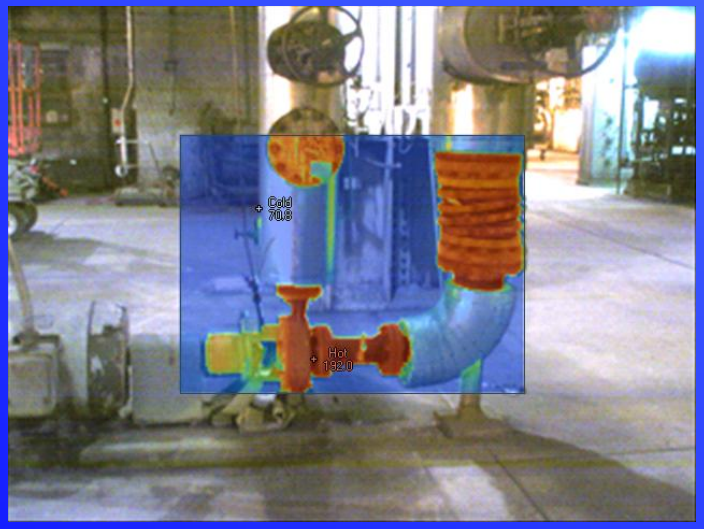
100

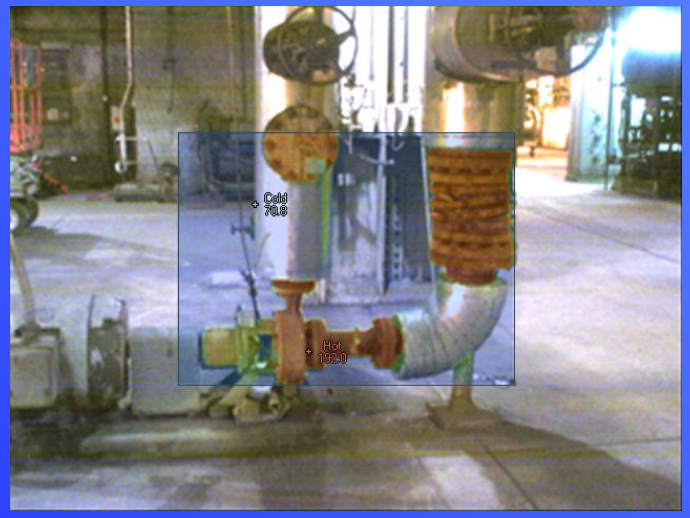




75

50

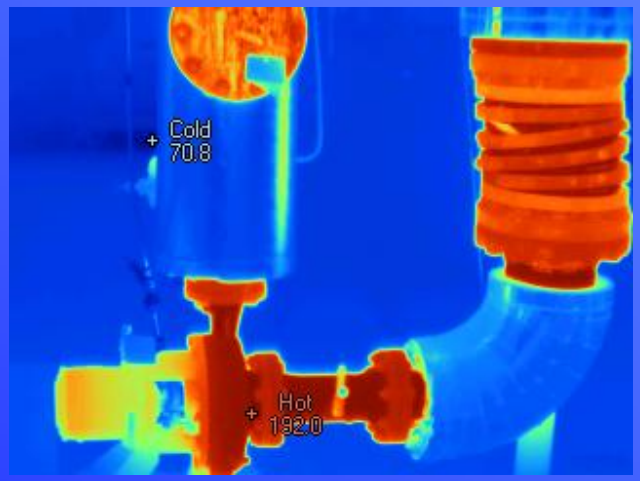




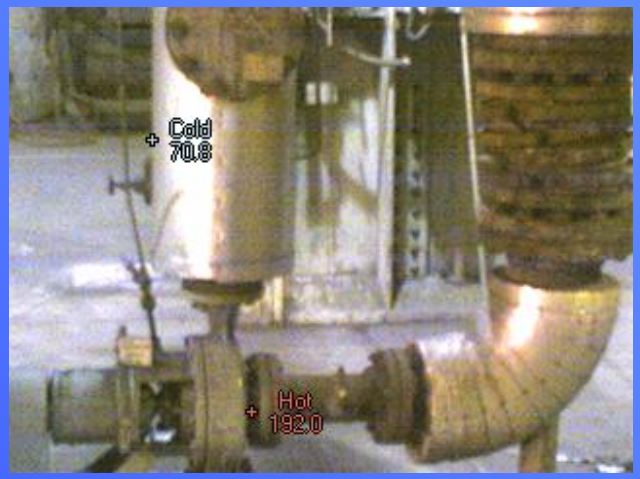
25

Full Screen Example

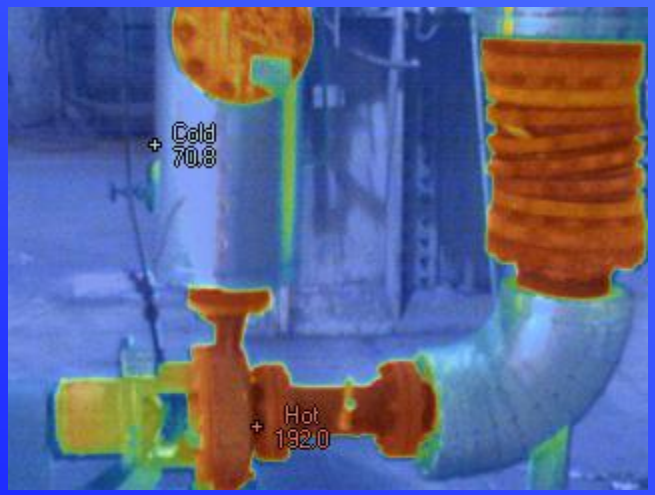
Infrared Image



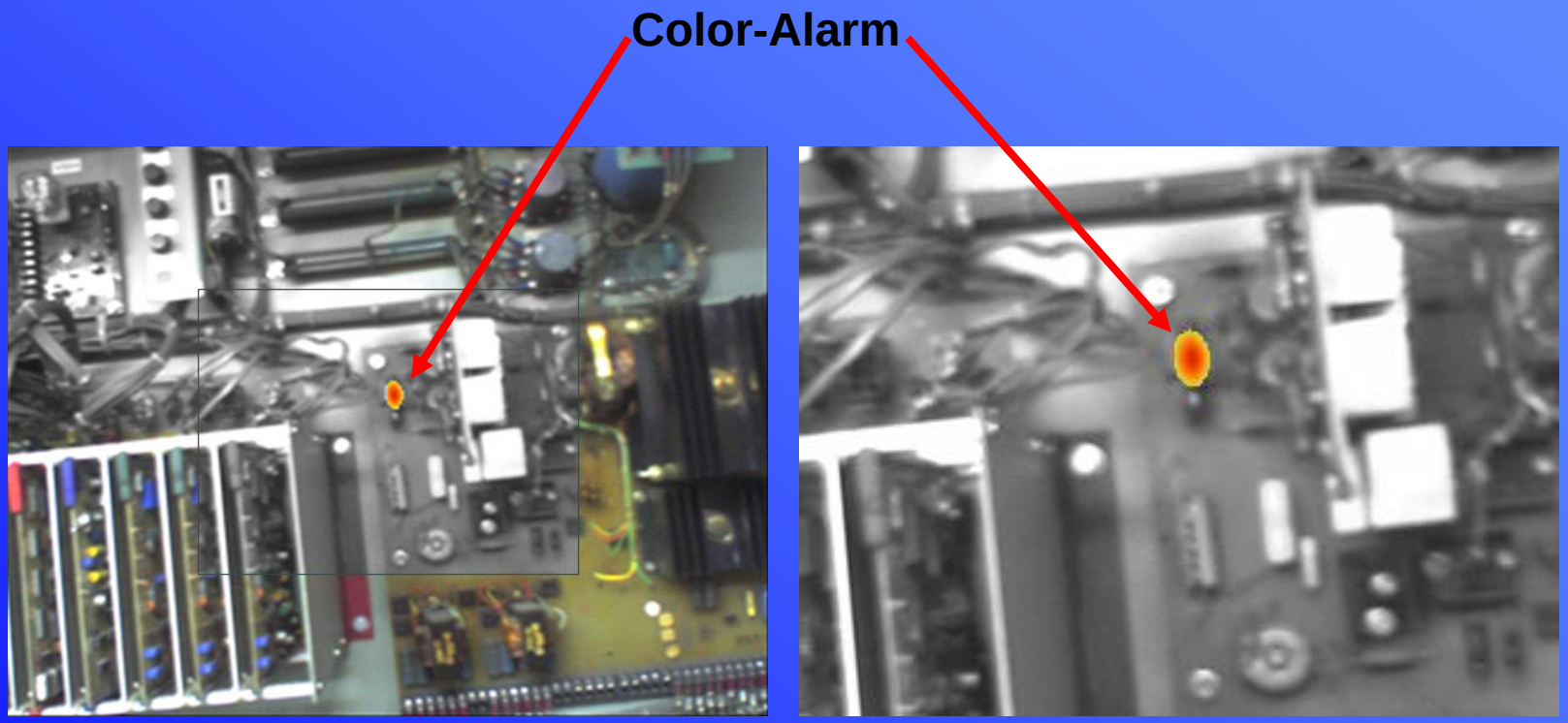
Visible Image



Blended Image



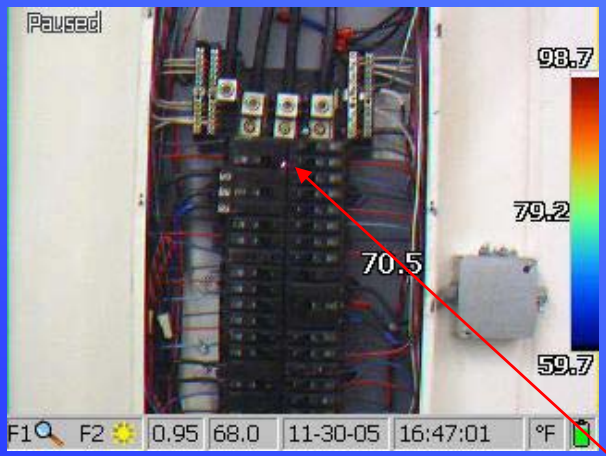
Color Alarm Example



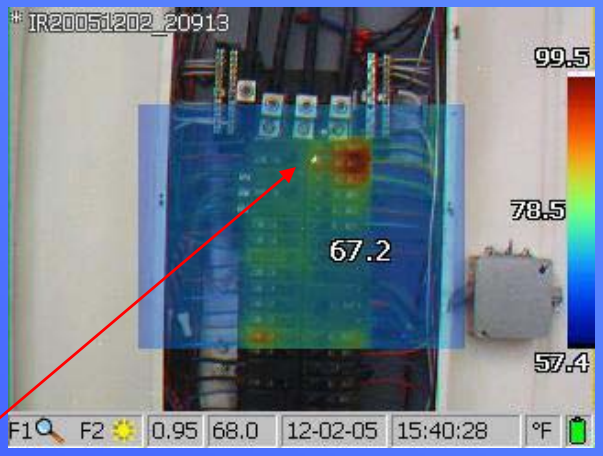
Picture in Picture

Full Screen

Laser Pointer Spot Seen in Visible and Blended Image

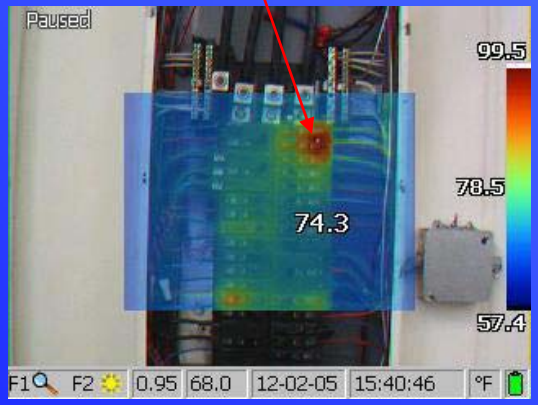


Visible



Blended

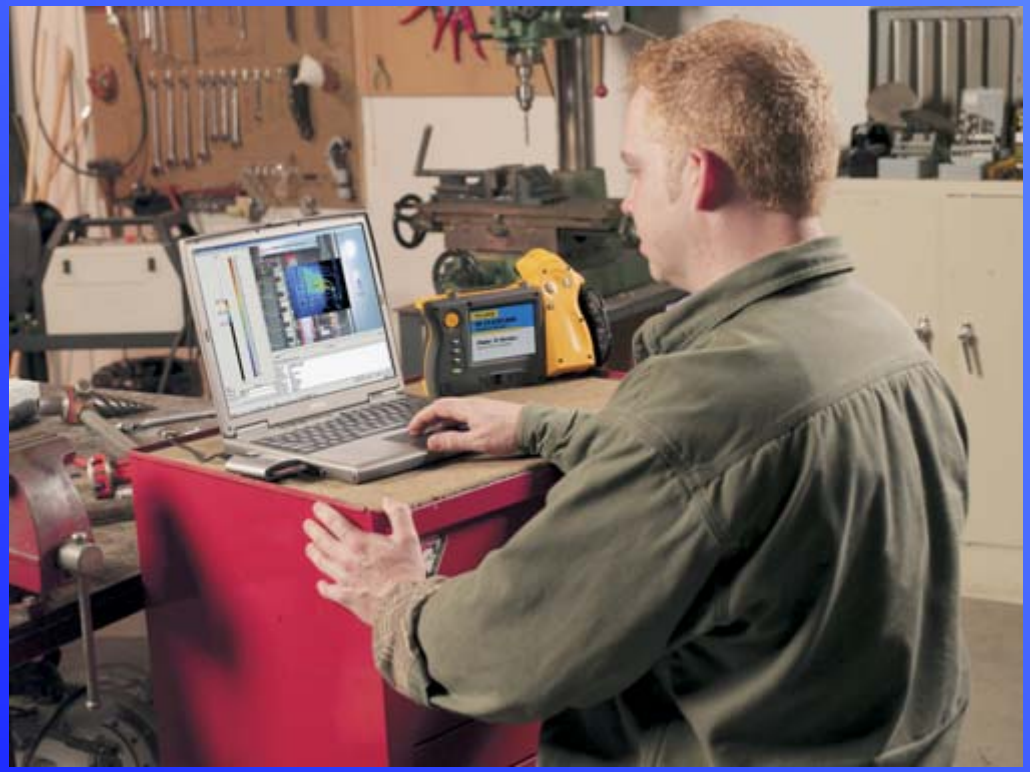
Laser Spot



Powerful analysis and reporting software

SmartView™ software

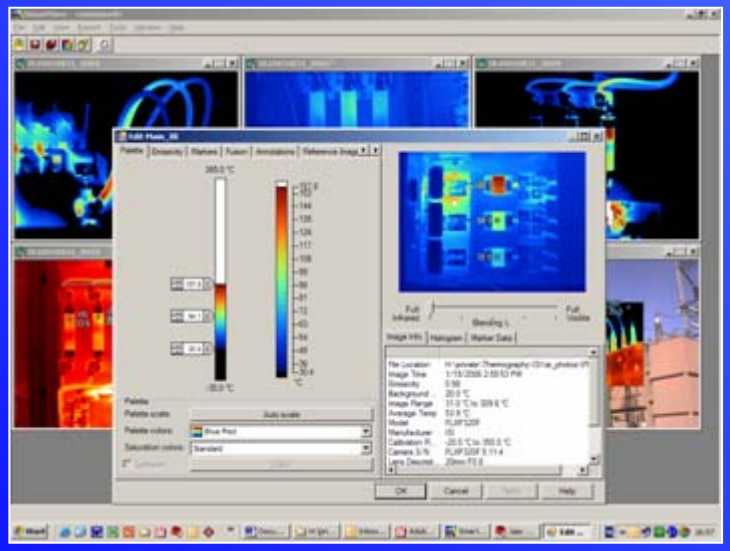
- Included with each IR FlexCam Thermal Imager

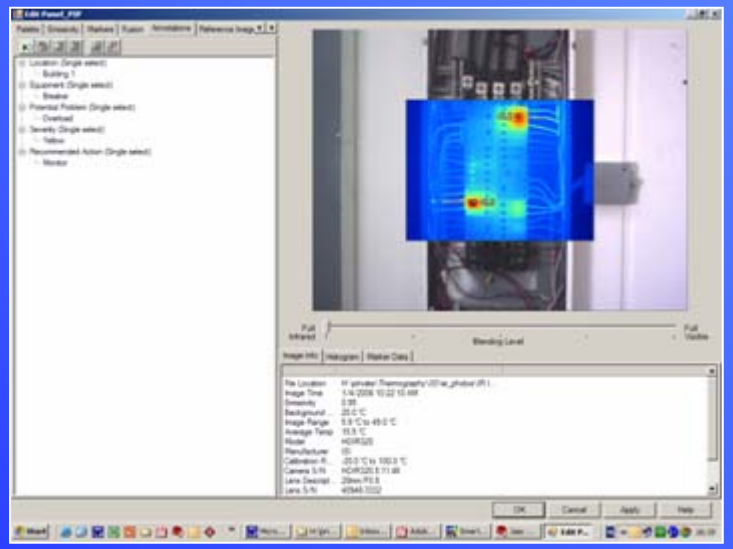


Powerful analysis and reporting software

SmartView™ software

- Image viewing and editing
  - Changes level and span settings
- Extensive annotation possibilities
- Detailed analysis and total image control
  - Same 5 viewing modes as on the instrument

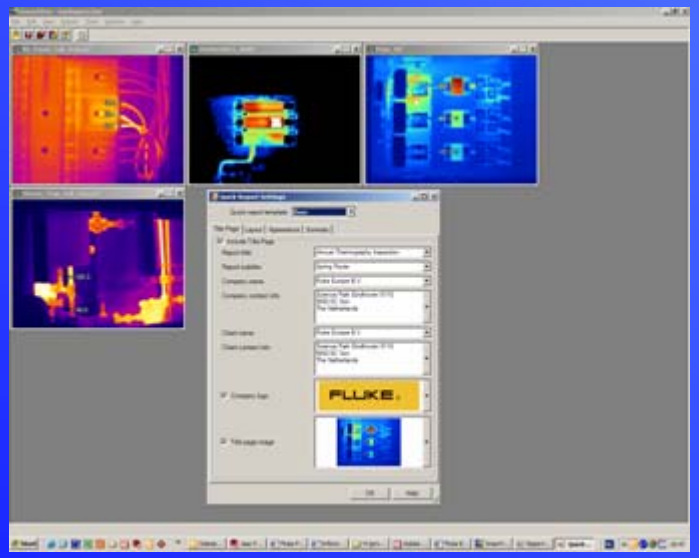


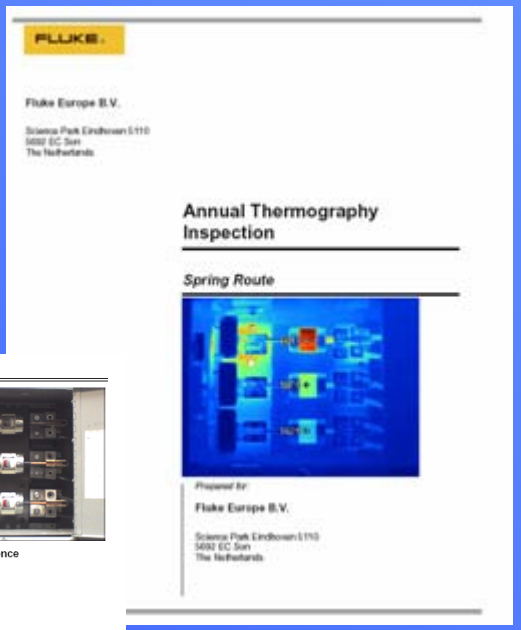


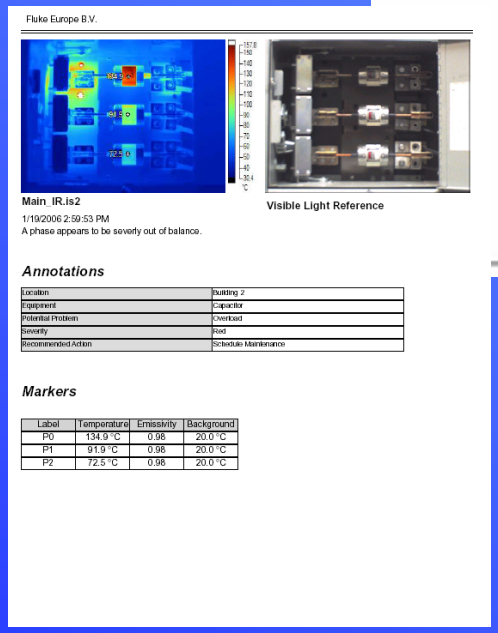
Powerful analysis and reporting software

SmartView™ software

- Simplified report generation
  - Allows for full user customization of report







And .....

- Standard up to 600 ºC (with option of 1200 ºC)
- All models fully radiometric
- Interchangeable lenses
  - Choice of 3 high quality germanium lenses
  - Standard 20 mm,
  - Wide angle 10.5 mm
  - Telephoto 54 mm
- Video output
- Rugged, battery-powered, IP54 rated

Lens Options

Wide Angle

Standard

Long Distance

Long Distance – Telephoto – 54mm

Long distance

- **Power line insulators / transformers**
- **Medium distance – small IFOVm objects**
- **PC Board design & testing**

Standard – 20mm

- **Most industrial PdM**
- **Most building Science applications**

Wide Angle – 10.4mm

- **Some Building Science apps**
- **Close-up but where wide view area is required**

Complete offering

- Heavy duty carrying case
- 2 rechargeable battery packs
- Battery charger
- AC adapter
  (for Ti45/Ti55 model only)
- Video cable
- 512 MB compact flash card
- Compact flash card reader and USB cable
- PCMCIA compact flash card reader
- Neck strap
- SmartView reporting and analysis software on CD
- User manual on CD

Introducing
Fluke Ti10 and Ti25 thermal imagers

The new Fluke Ti10/25
One look and feel – 2 different products

- IR-Fusion® Technology
  - Infrared and visual images fused together makes Infrared easy to understand
- Delivers the clear, crisp images needed to find problems fast
- Rugged, easy to use
  - What you expect from Fluke

Models for almost any application and budget

  - Comes as one complete package including everything you need

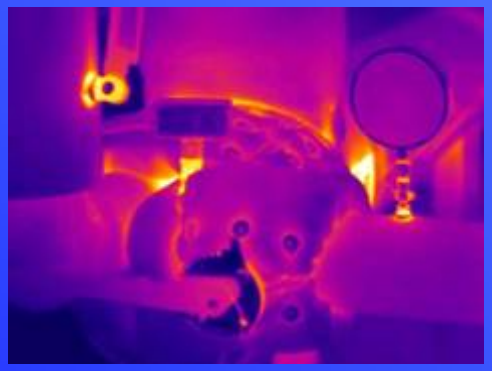
The new Fluke Ti10/25
One look and feel – 2 different products

Visual camera lens
Protective lens cover
Speaker for sound and voice annotation playback
Large, landscape format LCD display
2 GB SD memory card slot
Microphone for voice annotation
Picture-in-picture, full IR or blended high-quality image
Easy to use three-buton menu
AC adapter terminal
Focus ring
Thermal imager lens
Image capture trigger
Rugged, withstands 2 m (6.5 ft) drop
Wrist strap (adjusts for right or left handed use)
FLUKE
Ti25

The new Fluke Ti10/25 with IR-Fusion® Technology

- Makes infrared easy to understand
  - Don’t need to be a specialist to see and understand what you are looking at
- Makes reporting much easier
  - The reference with the “real world” is always there
- Provides different viewing modes to better identify trouble areas
  - On camera or in the software
- Until now only available in > $10k priced imagers

The new Fluke Ti10/25 with IR-Fusion® Technology

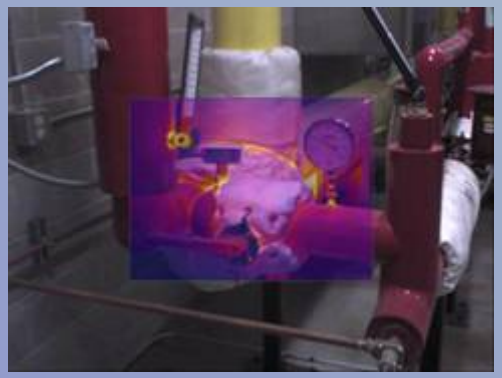


Max IR
(traditional thermal imaging)

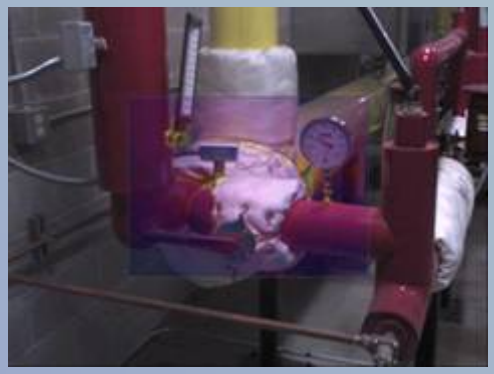
Mid IR

Min IR

PIP Max IR



PIP Mid IR



PIP Min IR

Ti25 and Ti10

Ti25 Only

The new Fluke Ti
Large crisp images

- Large, widescreen full color LCD display shows all details
- Identify even small temperature differences with excellent thermal sensitivity (NETD)
- High performance, low noise sensor provides high-quality, stable image

The new Fluke Ti
Made for rough environments

- Engineered and tested to withstand 6.5 ft. drop
  - Not even Fluke DMMs are tested to this specification
- Withstands dust and water
  - IP54 rating
- Innovative protective lens cover protects lens when not in use
- Works in ambient temperatures as low as 14 ºF and high as 122 ºF and measures up to 662 ºF (Ti25)

The new Fluke Ti
Easy to use

- Intuitive, three-button menu
- Single-handed operation
- Adjustable (left or right) hand strap makes imager convenient to hold
- Store more than 1200 IR-Fusion images on memory card for later analysis or reporting
- Supports 16 different languages

The new Fluke Ti
Thermal Imaging made affordable

- Priced between $4500 and $7500
- One complete package includes:
  - SmartView™ analysis and reporting software (with free upgrades)
  - Rugged hard case and portable soft case
  - Adjustable hand strap
  - 2 GB SD memory card
  - SD memory card reader
  - Internal rechargeable battery
  - AC charger/power supply

Introducing the Ti20 Thermal Imager

Introducing the Fluke Ti20

A thermal imager for Industrial use:

- Breakthrough price/performance
  - Analyze data and optimize images
  - Display high quality images
  - Easy to use
- Optimized for Industrial applications:
  - Professional Grade
  - Key measurement needs
- Great for predictive maintenance
- Complete offering

Breakthrough performance

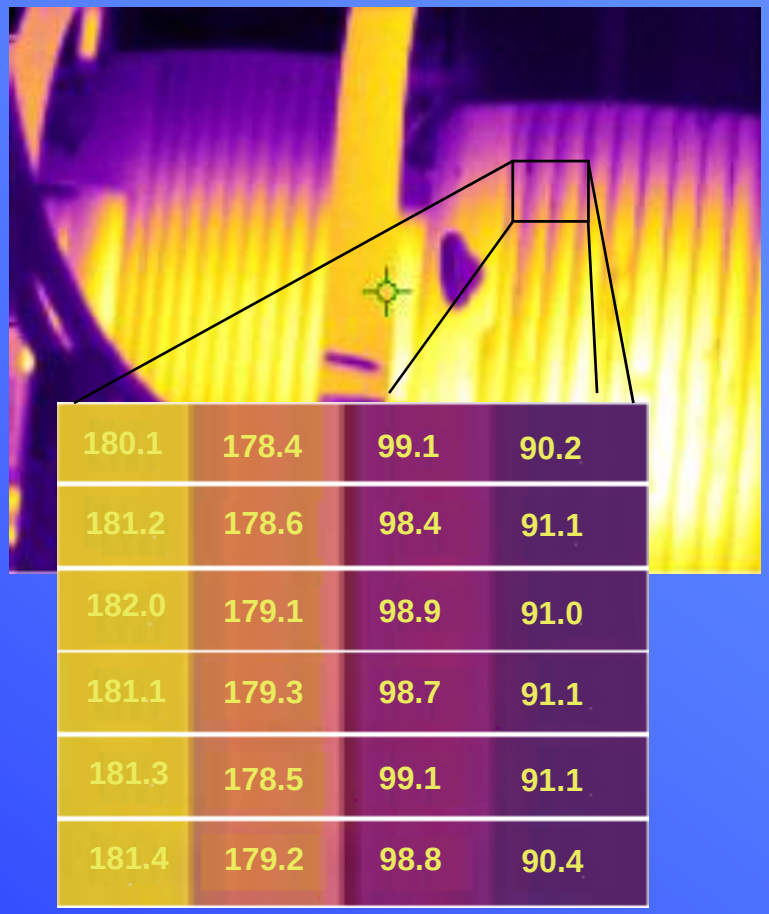
Analyze Images

Fully radiometric thermal Imager

- For detailed temperature analysis and trending
- Easily identify problems by comparing temperature data
- Calibrated temperature points
- Stores images and the data behind the image

Adjust key parameters in software afterwards

- Emissivity, palette, reflective coefficient
- Saves time by avoiding second measurements
- No need to go back on the factory floor



Breakthrough performance

Display high quality Images

High-resolution image

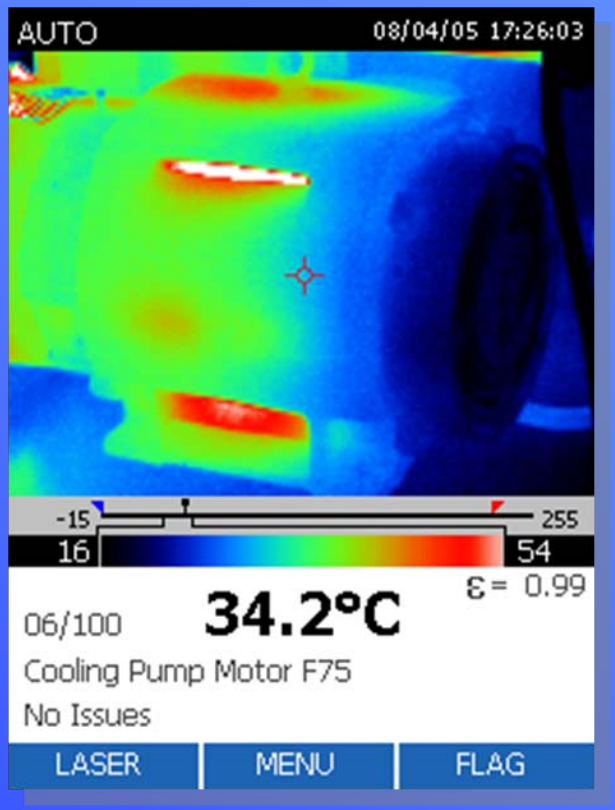
- 128 x 96 resolution

Large, bright LCD display

- Uncluttered full size image with data and separate part of the screen
- For use under every lighting condition

Separate display for picture and measurements:

- Can always see the temperature, other key measurements, and equipment ID
- Not so for competitors (e.g. Flir)



Breakthrough performance

Easy to Use

Single handed point; shoot and image capture operation:

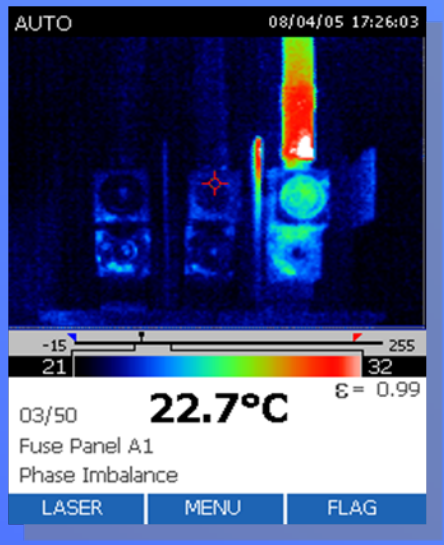
- Press the trigger to capture the image
- Compare with other images taken

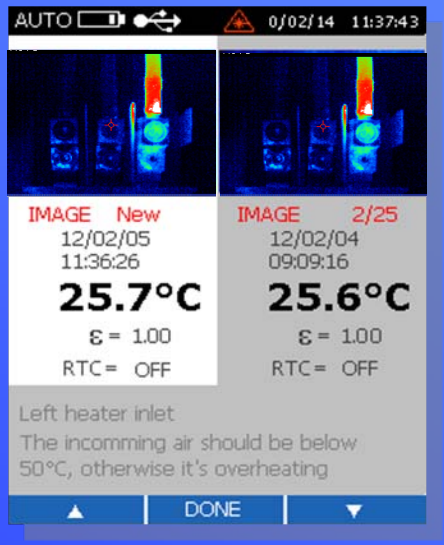
Automatically adjusts temperature level and span to display an image without pressing any buttons:

- Manually adjust level and span to further optimize picture
- Clearly displayed level and range indicator

Simple menu structure for intuitive use and getting started faster:

- Only three menu button navigation
- Ideal for multiple users (common for industrial settings)





For industrial use

Professional Grade

It’s a Fluke – rugged, battery powered unit

- Up to 6 hours battery life (using both rechargeable batteries supplied)
- Smart design protects lens for accidental drops etc
- Survives harsh industrial environment

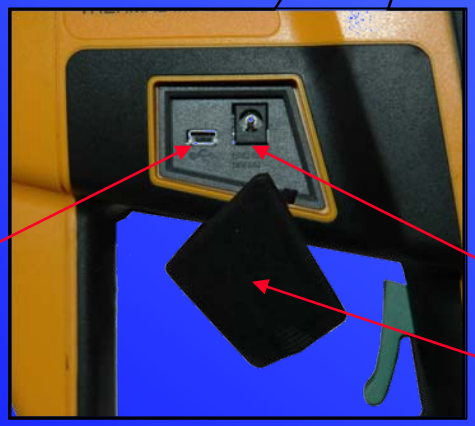
IP54 rated

- Water and dust proof
- Connections protected for moisture and water

Measures up to 662ºF (350ºC)

- Covers broad industrial applications

Overview of controls



Focus ring

Lens

Laser pointer

Trigger to store image

Large bright Display

Menu Soft keys

Battery compartment

Tripod mount (under imager)

AC adapter terminal

USB Port

Protection

Ideal for predictive maintenance

Supports inspection routing:

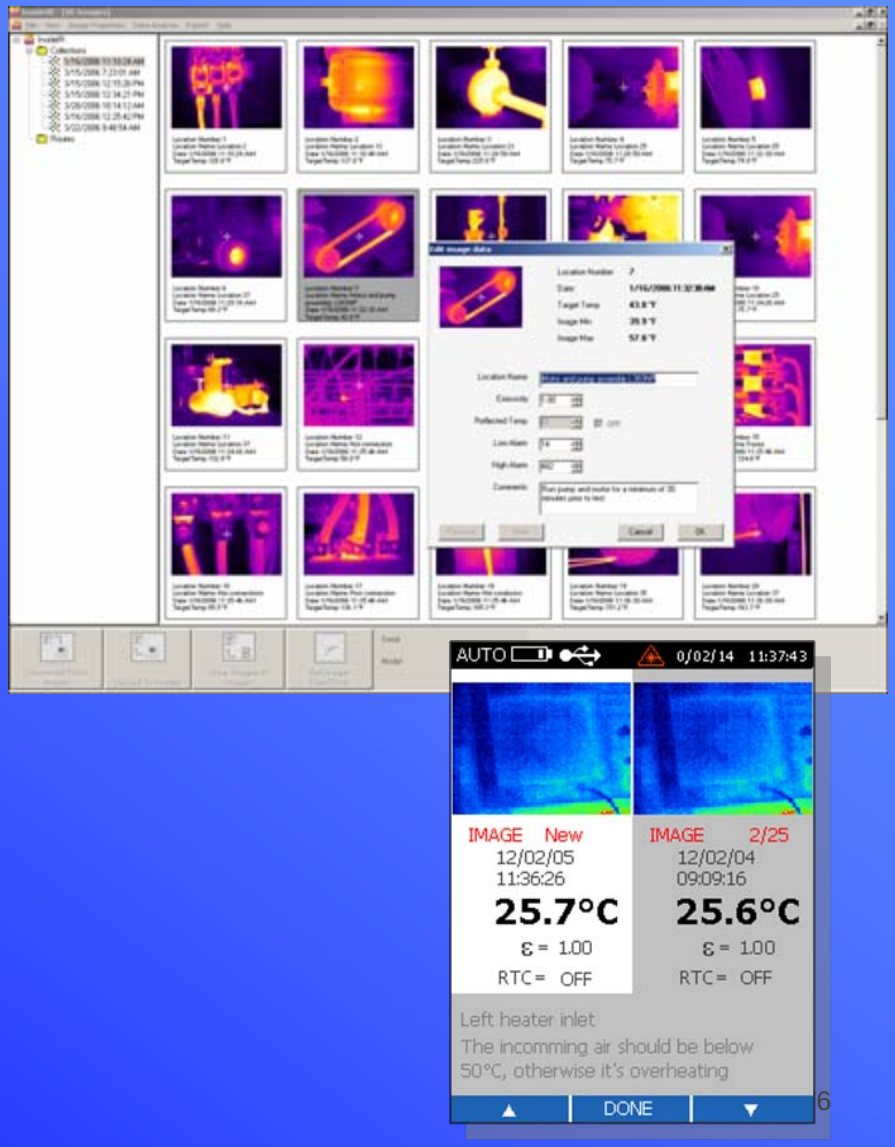
- Clear on camera instructions
- Anyone can do the job

Periodic inspections help to detect temperature changes:

- Establish baseline settings for equipment
- Early indications for potential problems

Compare images to ensure that the captured image is taken correctly:

- From the correct position and distance
- Increases quality and confidence in preventive maintenance program
- Reduces the need to go back and take additional pictures
- Before image stored



Fluke Ti20 Complete offering

InsideIR software reporting and analysis software included:

- Allowing unlimited use by your whole maintenance team with no additional cost
- Allows detailed analysis, storage and reporting.

Comes complete with all necessary accessories to start using right out of the box

Includes Professional application training materials to ensure quick learning and a fast return on investment

Training CD

Ti20
FLUKE
To get started, you need your Ti20 imaging system, the InsideIR software, and a PC running XP or the Windows 2000 or later operating system on which to load the software.
Ti20
FLUKE
The Electromagnetic Spectrum
Thermal
Wavelength in Microns (µm)
Ti20
FLUKE
Learing to use the
Fluke Ti20
GET STARTED
Ti20
FLUKE
Each of the 12,288 elements, or pixels, contains a temperature value.
128 Elements
96 Elements